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DREAMS THAT COME TRUE.

It is worth pointing out at this juncture, when the Union Engineering Building has become a certainty, that the idea has haunted the minds of engineers and scientists for at least a quarter century past. At the very outset of the American Institute of Electrical Engineers in 1884, the project was taken up, and as that body was then enjoying the hospitality of the Civil Engineers, it was under the roof of the Civils that it was more frequently discussed than anywhere else. There were in fact committees on the plan in those early days, but after all was said and done, the thing fell through, although everybody admitted its desirability. The times were not ripe, nor had the growing needs of the various national bodies given a real urgency to their search for a way of solving the difficulties. The project has now attained finality in a very desirable shape, and those who have watched its fate, with waning and waxing hopes and fears for two decades past, can once more rest assured and be reaffirmed in the conviction that a great idea never dies, but should be persisted in and advocated until its merits win out.

PETER THE PILGRIM

Following the excellent introductory notes of Brother Potamian in the two preceding issues, we print elsewhere in this issue a translation in full, specially made for our columns, of the epistle of Petrus Peregrinus. The Latin text used is that of Gasser, A.D. 1558, a copy of which rare work is in the Wheeler collection of the Library of the American Institute of Electrical Engineers. The letter of Pierre de Maricourt, commonly called Petrus Peregrinus (from having made a pilgrimage to the Holy Land), is the first great landmark in the domain of magnetical philosophy, and is rich in magnetic thought and suggestiveness. True, there have been writers from Thales and Lucretius down to Neckam and Roger Bacon, who wrote about the lodestone; but none of them stopped to investigate seriously its known properties or discover new ones, still less to devise means of applying them to the welfare of mankind. The credit of having done this and done it on an extensive scale, belongs unquestionably to Peregrinus, the Gallic friend of Friar Bacon, and at the same time the great magnetical man of the Middle Ages. His letter on the magnet, written in camp amid the din of war and the exigencies of his engineering duties, shows him to have been uncommonly gifted for original work and for delving deeply in the arcana of nature. In his researches he brought to light a great body of facts about the lodestone, tested them in numerous ways, co-ordinated them, and described them in due sequence in his famous "Epistola ad Sigerum," A.D. 1269.

If Peregrinus was a hard thinker and persistent worker, he was also a resourceful man in turning his discoveries to practical account. It may be held that Neckam knew of the pivoted needle before him; but if, after construing the Abbot's *acum jaculo superpositam* to mean that the support was the pointed end of an ordinary dart, we turn to the second part of the "Epistola," we will find in Chapter II a detailed account of the sharply pivoted needle of Peregrinus and an unequivocal statement of its use at all times in navigation. His magnetic motor is a startling conception for so early a period as the thirteenth century. We cannot but admire the ingenuity of the contrivance even if we do smile at the naiveté of the enthusiastic inventor, who flattered himself with the delusion that he had really contrived a perpetual motion wheel—little suspecting that he was realizing in himself his own words: "I have

seen many persons vainly busy themselves and even become exhausted with much labor in their endeavors to invent such a wheel."

Singularly enough, it was this selfsame harmless wheel that stirred up to the full the wrath of Gilbert when, forgetful of all Christian precepts, he used such unparliamentary language as "May the gods damn all such sham, distorted works which do but muddle the minds of students." Nevertheless, the writer of this invective was greatly indebted to Peregrinus, whose terminology he adopts and whose "terella" experiments he repeats. It is true that Gilbert refers five times in his "De Magnete," A. D. 1600, to this letter of A.D. 1269, but all that his gratitude inspired him to write of it is that it is "a pretty erudite work for its time." In reading this half-hearted admission, we must bear in mind that the philosopher of Colchester was as sparing in meting out praise as he was liberal in his censures and forcible in his denunciations.

Two works of comparatively recent date have it that Peregrinus, while emphasizing the attractive virtue of the lodestone, nowhere mentioned magnetic repulsion. This must be a *lapsus calami* and nothing more, for in Chapter VI we read: "Know then that this is the law: The north pole of the lodestone attracts the south pole of another, while the south pole of the one attracts the north of the other. Should you proceed otherwise and bring the north pole of one near the north pole of another, the one you hold in your hand will seem to put the floating one to flight. If the south pole of one is brought near the south pole of another, the same will happen." The law of repulsion is as explicitly stated here as it is clearly demonstrated.

AS OTHERS SEE US.

We have often discussed American engineering education in these columns—so often that we should hesitate to bring it again before our readers were it not for the paper read last month before the Institution of Electrical Engineers, which gives a transatlantic view of our virtues and shortcomings too valuable to be lightly passed over. The author, Dr. R. M. Walmsley, spent three months last year in investigating our engineering schools of various types, and succeeded in gathering an amount of practical information which we have not seen equalled in any similar investigation. And we may congratulate ourselves that the conclusions were of a flattering nature as a whole, especially in comparison with British conditions. Not only is the character of the engineering instruction upon the whole higher here than abroad, but the discrepancy in the number of students is something startling to the last degree. Dr. Walmsley found in sixteen of our prominent institutions 1,371 students in engineering courses who had been more than three years in attendance, while the latest available report in Great Britain showed but 56 students in the corresponding class. This difference does not so much indicate lack of facilities as difference in aims. Among first year and second year students, the comparison is upon more even terms, the truth being that with some distinguished exceptions the British technological schools are substantially what we would know here as trade schools, from which the pupils frequently pass into their technical pursuits without waiting to complete the course. This difference is emphasized by the undoubted fact that the average student material here and in Canada is drawn from a relatively better class than in England. As Dr. Walmsley remarks, the engineering professions there have to come into severe competition for personnel with the Army and Navy, the Indian and other public services.

He might have added that engineering is generally considered as too deucedly near to trade to attract on the whole a high grade of student material. The early efforts at scientific education in technical schools even in this reputedly democratic country suffered not a little from the same source. It would not have been quite a polite thing to say at the time, but twenty-five years ago engineering did not have its present standing among the professions, and the old classical colleges unquestionably got the pick of the student material. These social differences reach even further. We have had in this country a great many men in high commercial and technical positions who have risen from the ranks, and we are justly proud of them; but it is undeniable that the activities of our country for the past fifty years have been in greater proportion directed by college-bred men than in any other country in the world, with the possible exception of Germany. The result is that those who now direct our activities are in more than usual close sympathy with education, technical and other, and appreciate the advantage of drawing into their service young men with the best possible training. Hence, the conditions noted by Dr. Walmsley in regard to the demand for technically-trained men in American manufacture. The moral can in no wise be better pointed out than by mentioning that Charles William Eliot narrowly escaped becoming the manager of a cotton mill the year before he was elected president of Harvard College. We do not wish to be considered discouraging, but we do not see how technical education in England can be put firmly upon its feet until certain points of view are very considerably modified. When the well-to-do and well-born young Englishman heads for the engineering profession as freely as he heads for the Army or the Church, things will begin to go differently.

Dr. Walmsley, in way of criticism, puts a keen analytic finger on the very points which we have often recognized as weak spots in our technical education. His many conversations with American manufacturers brought out as the most general criticism "that in many cases the training is too superficial and too apt to overload the student with a large and confused assortment of facts instead of training him in principles, this being in a large measure due to attempts to deal in too much detail with a crowd of subjects, especially in the last year of the course." And with respect to one egregious fad in recent education, Dr. Walmsley remarks: "It is a matter for serious consideration whether the excessive amount of time given to manual work in the manual training schools has not been dearly purchased at the expense of starving the time which should have been given to mental training." We wish that some of our strenuous and solemn-visaged educators who spell themselves in large capitals and have so little sense of humor as to take themselves seriously, would cut out these two quotations and paste both into their hats. As things are at present, the higher technical institutions are busy for no inconsiderable part of the course in stopping the gaps left by kindergarten foolishness of various sorts in the primary and secondary schools. They admit students at eighteen or nineteen years of age and then spend the better part of two years in teaching them the elementary English, mathematics and modern languages that have been neglected in the secondary schools, to make room for nail-driving, music, painting and emasculated physiology. It is vast credit to the technical schools that in a four-years' course they can turn off the material they do in spite of inefficient preparation. Our English friends in trying to build up a system of technical education will at least have less foolishness to contend with at the start. The thing most needed over there, however, is the sympathetic assistance of the great universities. So long as they hold aloof from directly encouraging technical students, the tremendous weight of their centuries of social influence will stand against improvement.

THE TELEPHONE REPEATER.

To one who might undertake to study the course of invention by reference to Patent Office records, the telephone repeater, from its

numerous entries, would appear to be at least holding its own in the rapid progress of telephonic development. As a matter of fact, all the work of inventors in this branch during the past twenty years or more has thus far brought forth absolutely no practical result. This condition appears to indicate that in this perhaps more than in any other department of invention, the inventor is prone to apply for a patent without having first determined by practical trial if his apparatus will really in actual work over long-distance lines perform the functions for which it is devised; and in the present case this is the more inexcusable from the fact that opportunities for such a trial are nowadays within easy reach, and involving small expense either in apparatus or test. A successful telephone repeater is the great need in telephony, and its inventor would be abundantly rewarded materially, which undoubtedly accounts for the scores of patents that have been issued on "telephone repeaters"; yet of all these we do not know of one that has been put to public test on a circuit of sufficient length to demonstrate its capabilities. The uniformly negative results thus far may, however, be ascribed, not to any undue lack of inventive skill, but to the enormous difficulties in the way of renewing the energy of voice currents without affecting their speaking characteristics; that is to say, the difficulty of strengthening in absolutely equal proportion each element of a current varying enormously in frequency and in amplitude. The introduction into a circuit of repeating apparatus is in itself apt to destroy the speaking characteristics of the current to be repeated, even before it undergoes any supposed process of reinforcement. The futility of effort thus far indicates that the telephone repeater, if it is ever realized, will be based upon some radical discovery, perhaps second only to the discovery of the telephone itself. In the meantime, the record of past failure indicates that effort will be wasted in endeavors to realize a telephonic repeater through mere mechanical combinations of parts and without reference to the fundamental physical principles governing the generation and transmission of the telephonic current.

THEORIES OF WIRELESS TELEGRAPHY.

Our correspondence columns last week contained an interesting letter from Prof. A. Blondel on the subject of wireless telegraph theory. A few years ago, in fact as recently as 1900, a great diversity of opinion existed as to the nature of the waves employed in wireless telegraphy, and as to their mode of propagation. Now, however, there is very little difference of opinion outstanding, and the latest stones in the structure of the theory have been laid by the papers of M. Blondel. The gist of the whole theory lies in the recognition that the wireless telegraph waves are essentially the same as the waves produced and studied by Hertz, except that a sheet of conducting material, namely, the surface of earth or sea, occupies the midplane of the system, and that one-half of the system, i. e., that beneath the conducting plane, is abolished. The semi-system then remaining above the conducting sheet travels just as though the sheet were not there, so long as the sheet remains in the midplane. As soon as it bends out of the midplane, as by the curvature of the earth in the telegraph case, the pure Hertzian system becomes modified by the presence of the sheet, to the extent of bending over, or conforming to, or being guided by the sheet, and the waves, therefore, depart from their original rectilinear path. Add the secondary effects of attenuation at the surface of the earth due to imperfect conductivity, the tearing of gaps or rents in the wave by the presence of local conductors on the earth, such as structural steel buildings, lightning conductors, or receiving antennæ, as well as the possible influence of conducting strata high in the atmosphere, and the Hertzian wave theory applies at once to the wireless telegraph case. The views that have been expressed by Messrs. Blondel, Fessenden and ourselves are all in essentially complete accord.

Perhaps the easiest picture to form, in the mind's eye, of a wireless sheet wave is to consider a net, like an enormous seine or fishing net, invisible to the eye, emitted from the sending antenna and running out from it at the speed of light in all directions, spreading as it runs. If the cord of which the net is made is barbed, so as to mark the direction of weaving, the positive side of the wave will differ from the negative in the directions of these barbs. After a few wave lengths from the origin, the net will occupy the form of an inverted hemisphere. At the ground the horizontal lines, or the warp, will represent magnetic flux lines; while the vertical lines, or the woof, will represent electric lines. The net propagates itself everywhere, at light speed, in a direction perpendicular to the surface. It tries to get away from itself sideways. Every cord in the net extends elastically from the tension due to moving sideways. The net is constantly increasing in dimensions, and in the length of each cord as it advances. But no cord moves at any time in the direction of its own length. That is, the pull along any cord in one direction is exactly balanced by the pull in the opposite direction, so there can be no resultant force, or component of force, along any cord, tending to move it longways. All the pull which gives rise to movement makes each cord travel sideways, or perpendicularly to its length and to the net.

There is this curious analogy between the electromagnetic net and a material net moving over the ground. If the ground were absolutely smooth and perfectly frictionless, a vertical fishing net carried over the ground so that the lower edge just touched would not be bent from the vertical by the contact. This would correspond, in the case of the electromagnetic net, to a perfectly conducting surface. There would be no bending in at contact with the ground. But if the net were dragged over a rough surface it would be bent, at the lower edge, out of the vertical plane by the friction. This corresponds to imperfect conductivity in the electric case; the net becomes frictionally bent back at the surface, to a greater or less extent, and the wave at the ground, moving always perpendicular to its own surface, runs into the ground, thereby dragging part of the net after it and bringing about extra attenuation of the fibres.

Moreover, if the material net were carried over posts or obstructions at a sufficiently rapid rate, rents would be torn in the bottom of the net, and at the gaps the edges of the net would be bent back by the contact, or out of the perpendicular plane. So in the electric net, a brick wall is no obstruction, but a metal rod or a lightning conductor takes the part of a post in the material case, and tears a gash out of the net. The edges of the net at the gash are, however, bent back as they tear, and as the net moves on the edges take a lateral or sideways motion, in addition to the regular advancing motion, tending to draw the edges of the rent together, and seal up the gash, at the same time drawing upon the net as a whole to do this, and executing the repair with some general attenuation. The electric net, being bent at the gash out of the regular shape, can mend itself automatically by taking a component of force and motion that would correspond to longways propagation in the uninjured net. Assuming that we have a clearly defined working theory of the nature of wireless telegraph waves, we need convenient means of experimental exploration in the air and open field in order to make rapid progress in our knowledge of the subject. What we want is a measuring instrument so sensitive that when connected in the middle of an exploring rod observations can be collected in many different directions and at many different elevations.

Incandescent Lamp Patent Infringement Suits.

The Edison Electric Light Company, now a part of the General Electric Company, has instituted suit against 15 manufacturers of incandescent lamps and ten supply dealers, for infringement of two patents relating to means for exhausting lamps, and one patent on a detail relating to leading-in wires. The two first-mentioned patents are that of Malignani on the method of chemically completing the exhaustion of lamp bulbs and an improvement thereon patented by Mr. John W. Howell. The third is an Edison patent, which provides for sealing in glass, the junction between the platinum and copper leading wires, these wires being welded and the glass then squeezed around them from a piece of tubing. It is claimed that by this method of sealing the junction in glass any danger of the wire working up and down and causing air leaks is obviated. The date of the Malignani patent is April 16, 1895, the number being 537,693; the Howell patent, No. 726,293, is dated April 28, 1903; and the Edison patent No. 444,530, is dated January 13, 1891.

Use of Electricity in Mines.

The growing use of electricity in mines in England led the British Home Secretary to appoint a Departmental Committee to consider and report on the subject; and the report has recently been published. The committee state the following as the general principles which they consider should govern the employment of electricity in mines:

1. The electric plant should always be treated as a source of potential danger.

2. The plant, in the first instance, should be of thoroughly good quality, and so designed as to insure immunity from danger by shock or fire; and periodical tests should be made to see that this state of efficiency is being maintained.

3. All electrical apparatus should be under the charge of competent persons.

4. All electrical apparatus which may be used when there is a possibility of danger arising from the presence of gas should be so enclosed as to prevent such gas being fired by sparking of the apparatus; when any machine is working every precaution should be taken to detect the existence of danger, and on the presence of gas being noticed, such machines should be immediately stopped.

In regard to (1) and (2) they point out that under the peculiar conditions existing in mines, no absolutely safe voltage limit can be stated. Under the circumstances they have decided, on grounds that have been already recognized in Germany, that with the adoption of all reasonable safeguards a fairly high pressure has advantages, even from the point of view of safety, over a uniformly low pressure. With this end in view, the voltage to be used in-bye is to be the medium standard adopted by the Board of Trade, namely, 650 volts. The main thing is that electricity at any voltage should be recognized as possessing very great elements of danger and treated accordingly. That all electrical apparatus should be under the charge of competent persons will meet with general approval. By far the greater proportion of accidents arising from the firing of shots have been caused by disregard of this rule. As to the working of coal cutters in places subject to firedamp, the committee consider, largely as a result of experiments made, that it is necessary to enclose the entire motor in a flame-tight cover. One important result of these experiments was to demonstrate the possibility of overcoming the heating of the parts due to ironclad construction by ventilating the machine through the armature bearings on the same principle as a Davy lamp.

The committee have adopted the view that all permitted explosives should be fired by electricity, and that the armored covering of all protected cables should be earthed. The first of these ordinances says the British *Colliery Guardian,* will be generally approved, a similar rule having been adopted in Lancashire for some years. Accidents that have occurred with electrically-fired shots have, in almost every case, been caused, not by the electricity but by carelessness or insubordination, and where the system has been efficiently carried out, the result has been a great reduction in the number of miss-shots and a general saving all around. With regard to the second point, there are no doubt many experts who do not approve of the earthing of the armoring of a cable, but as the question is not one of cost and both systems have their advantages, such a dispensation, for the sake of uniformity, should not be objected to.

In concluding their report, the committee suggest that the rules they have drafted should be introduced immediately. A very important reservation from the colliery owners' point of view is that giving the inspectors discretion to revise existing installations. Other provisions are those enabling an inspector to dispense with any rules in any case in which the special circumstances appear to him to render such exemption necessary, and providing for arbitration, as in the enforcement of special rules where any difference of opinion may arise between an inspector and an owner as to any requirement under the same section.

Finsen Light Treatment.

United States Consul Frazier, of Copenhagen, Denmark, reports that in the Finsen Medical Light Institute, now a State sanitarium, 1,367 cases had been treated up to May, 1903, by the Finsen rays. Of these most were lupus vulgaris and in about 1,000 cases the best results had been attained, so that "in most cases one may count definitely upon a cure," to use the official language.

Seventy-five American doctors went to Copenhagen last year expressly to visit the Institute from all sections of the United States. Many of them purchased "Finsen lamps" with a view to establishing institutes for the treatment of skin diseases by the Finsen method. There were eight patients at the time of the report from various parts of the United States. Most of them assert that they were under treatment for years in the United States and employed eminent specialists in various centers of population at home, but that they were unable to secure a satisfactory diagnosis of their affliction; that the various specialists consulted did not agree; and that after years of discouragement and suffering, having heard of the Finsen light treatment they went abroad. Of the eight American patients it appears that all but one had their cases diagnosed satisfactorily at once upon reaching the Institute and have been given hope of final recovery. The doctors at the Institute are extremely conservative and never promise to effect a cure; but the records show that in a majority of cases where sufferers have been encouraged by being admitted as patients cures have been effected. In the one case of the American patients where the physicians have not yet determined whether they can give relief, it appears the patient is suffering from a rather deep-seated cancer, and the Finsen rays do not cure any but the more superficial cancers.

This report does not pretend to discuss the Finsen treatment in detail. It consists of the application to the diseased part of electric arc light, concentrated by a series of lenses and filtered through distilled water, which process of filtration removes the heat rays, but preserves the violet, ultra-violet and blue rays, the chemical and bacterial effects of which are such as to destroy the disease germs of lupus vulgaris and various other skin diseases, curing the diseases apparently for all time.

There are large Finsen institutes in various centers, notably in London, Paris and Berlin, but it is natural that all look to Dr. Finsen and his able assistants at Copenhagen for leadership.

St. Louis Headquarters N. E. L. A.

Mr. James I. Ayer, the progressive and efficient chairman of the Committee on Relations with Kindred Organizations of the National Electric Light Association, announces that arrangements have been made by which the Association will have permanent headquarters at the St. Louis World's Fair, consisting of a railed enclosure furnished with chairs, a convenient desk, stationery, etc., for the use of its members. The office will be in a section used also for an Edison Historical Exhibition, the headquarters of the Association of Edison Illuminating Companies and the headquarters of the American Institute of Electrical Engineers. Members will undoubtedly find this agreeable for a meeting point and a convenience in many ways while at the Exposition. A register will be provided and it is desired that all members visiting the headquarters register their name, local address and probable duration of visit. It is believed that this register will be of much value to visiting members, as well as an indication of the usefulness of a headquarters at an important Exposition.

On Turbo-Dynamos.—II.

(Concluded.)

BY PROF. DR. F. NIETHAMMER.

I HAVE arranged a collection of the formulas for calculating the mechanical strains grst on all important parts of a rotating direct-current armature running with speeds up to 80 to 100 meters per second, which should never be exceeded for economical reasons:

(*a*) The active sheet-iron ring, which is not split in all turbo-dynamos, has to resist a maximum tensile stress from centrifugal forces of $\sigma_e = 0.8 \times 0.082\, v_s^2$ kg. per sq. cm. (v_s = circumferential velocity in meters at the root of the teeth). For v_s = 80 meters per second, which is sometimes used, we find σ_e = 400 kg. per cm².

(*b*) The roots of the teeth are acted upon by a radial tensile strain,

$$\sigma_e' = \frac{\frac{w_t\, v^2}{g\ r} + \frac{w_w\, v^2}{g\ r}}{b_t\ .\ l} \text{ kg. per sq. cm.}$$

w_t = weight of one armature tooth in kg., w_w = weight of the copper of one slot between flanges, g = 9.81; v = approx. outside velocity of armature in meters per second, $2r$ = armature diameter

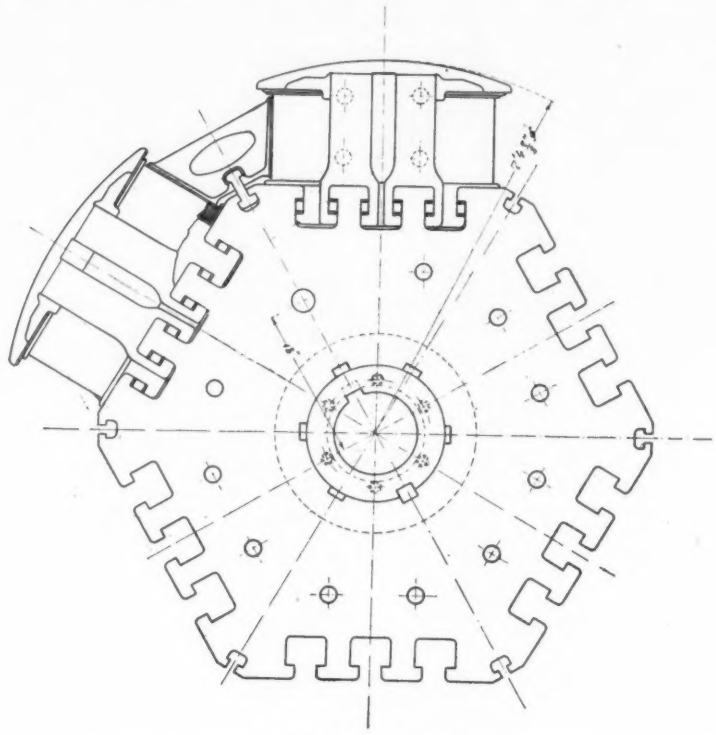


FIG. 6.—UNION COMPANY'S ARMATURE WINDING.

in meters, b_t = breadth of a tooth at root in cm., l = axial length of a tooth in cm. The centrifuga¹ force of the windings is supposed to be transmitted to the teeth by wooden or mostly by metallic wedges. For an armature like Fig. 4, with v = 100 meters, σ_e' comes out 200 kg. per cm².

(*c*) The wedges which serve to help the windings of the slots in place are bent by a specific load of bending stress,

$$\sigma_b = 0.8\, \frac{\frac{v^2}{r\, g}\, w_w\, b_s}{l\, s^2} \text{ kg. per sq. cm.}$$

b_s = breadth of slot at top (equal to breadth of wedge); s = thickness of wedge; l = length of wedge, all in cm. For a wedge of 5 mm. thickness we find σ_b = 500 kg. per cm²., which is quite inadmissible for wood.

(*d*) The end connections, which are usually built up as a barrel winding, are usually protected by a seamless (nickel) steel ring (Fig. 4) or specially good bending wire in several layers. This solid or wire ring has to bear a tensile stress of

$$\sigma_e'' = 0.082\, v^2 + \frac{w_e\, v^2}{g\ r} \cdot \frac{1}{2\pi\ l_r\ s_r} \text{ kg. per sq. cm.}$$

w_e = copper weight of the end connections of one side in kg.; $l_r \times s_r$ = section of ring in sq. cm. For the above example (Fig. 4), with v = 100 m. we get σ_e'' = 800 + 2,000 = 2,800 kg. per cm.², a very high strain. The ring or binding wire ought to be drawn on the winding with a tension equal to σ_e'' in the erecting shop to avoid loosening when running full speed; usually this is not possible in a perfect way.

(*c*) The commutators have to run with speeds up to 50 meters per second. The high centrifugal forces are absorbed by insulated shrinking rings (Fig. 4) put quite close together, or the commutator is composed of a series of very short commutators of usual design. The bending strain of the commutator segments is, in the case of shrinking rings, a cm. apart from each other:

$$\sigma_b'' = \frac{w_s\, v_k^2}{g} \cdot \frac{a}{r_k\ {}^8/_6\ s\, h^2} = \frac{8.9}{1000\, g} \cdot \frac{v_k^2}{r_k} \cdot \frac{a^2}{1.3\, h} \text{ kg. per sq. cm.}$$

w_s = weight of one commutator segment in kg. so far as it lies between two shrinking rings; g = 9.81; v_k = circumferential speed of commutator in meters per second; $2r_k$ = commutator diameter in meters; s = mean thickness of a commutator segment in cm.; h = height of commutator segment in cm. For v_k = 50 m. per second; r_k = 0.15 m.; a = 25 cm.; s = 0.75 cm.; h = 4 cm., one finds:

$$\sigma_b'' = 1{,}500 \text{ kg. per cm}^2.$$

This value is excessively high for copper.

The shrinking rings on the commutators have to withstand the whose centrifugal force of the commutator segments and of their own weight. Their section is determined in the same way as in case *d*. Put G_c = entire commutator copper weight in kg.; l_s = entire axial

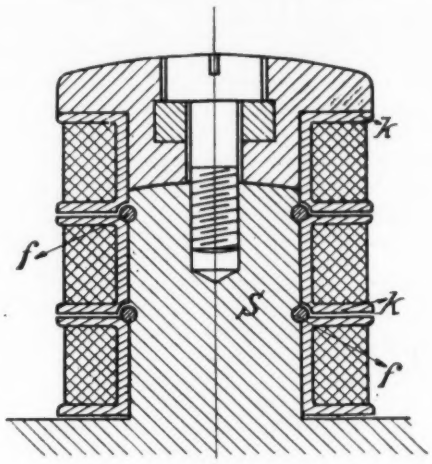


FIG. 7.—SUBDIVIDED COILS.

length of all shrinking rings, together in cm.; s_s = radial height of same in cm.; v = speed of the shrinking rings in meters, then the tensile strain in the rings is

$$\sigma_e'' = 0.082\, v^2 + \frac{G_c}{r_k} \cdot \frac{0.8}{2\pi\ l_s\ s_s} \text{ kg. per sq. cm.}$$

The rings have to be shrunk on the commutator with a tension at rest equal to σ_e'' to avoid a loose commutator at full speed. In the above example one finds

$$\sigma_e'' = 300 + 500 = 800 \text{ kg. per cm}^2.$$

For all the cases mentioned the remark holds good that mostly the strains only depend on the circumferential speed v and not on the diameter of the rotating part.

For three-phases, the rotating field type is nearly universally adopted. The material for the field wheels of high speed consists either of best cast steel or of solid forged iron or of piled thin iron sheets of 0.5 to 3 mm. thickness. The most important part, the field winding, may be

(*a*) A *copper strip winding*, the strips *on edge* wound on definite poles; the overhanging parts of the coils must be specially fastened by clamps and angles (Fig. 6, German patent No. 141,295, of the Union Company).

(*b*) A *wire winding* on definite poles, which as a whole is least to be recommended. The coils ought to be subdivided and protected by heavy flanges or spool boxes (Fig. 7); the centrifugal force of each bobbin may be directly transmitted to the pole or pole piece by rings, *f*. (German patent, 134,755). Parsons threads the wires (Fig. 8) through many holes, *e*, in plates riveted or screwed to the

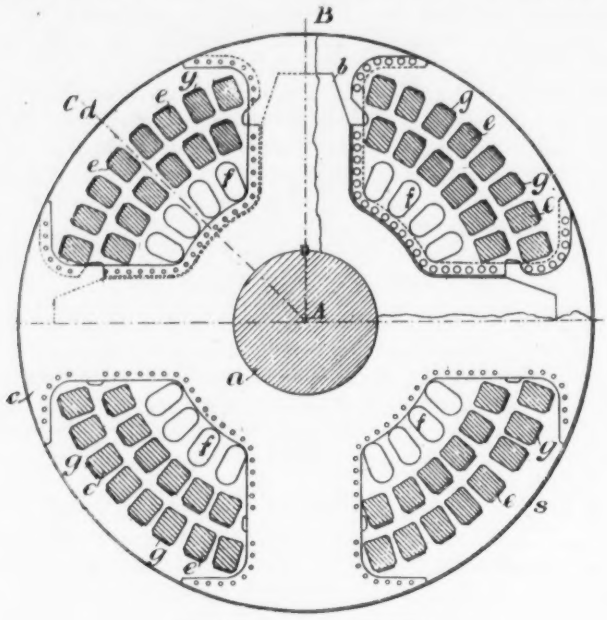


FIG. 8.—PARSONS WINDING.

field star (English patent, 5,907, year 1902), the end connections being fastened by a closed ring.

(*c*) A *definite pole winding distributed in slots* (Fig. 9, German patent, 143,119, of the Westinghouse Company) to divide the effect of the centrifugal forces on the coils; Brown, Boveri & Cie have been using this scheme for some time (German patent, 138,253).

(*d*) *A usual direct-current drum winding* (barrel wave winding), split and connected in such a way that the exciting current may be brought to the winding by two slip rings.

(*e*) A *ring winding* (Fig. 10[2] of the Maschinenfabrik Oerlikon), which for *2p* poles has to be divided into *2p* coils connected up alternately in opposite sense. The winding must be composed of very high bars. Fig. 10 represents a case for 1,200 kilovoltamperes and 1,500 revolutions; exterior field diameter = 860 mm., iron length between flanges = 850 mm.

In every case the exciter voltage has to be kept low, and the section of the exciter winding large, as the number of poles is very small in all turbo-alternators, even of high periodicity, and as it is desirable to have no considerable potential difference between two consecutive turns. The high mechanical pressures on the rotating winding, of 200 kg. per sq. cm. and more, may cause break-downs and leakage currents between adjoining turns, if one does not take special care; the surface of the copper must be absolutely smooth and the insulation layer sufficiently thick and resisting. Ordinarily the exciter voltage is only about 20 to 50 volts.

For some time turbo-alternators were built with rotating armatures and outside field frames (Parsons), the armature slots being perfectly closed and the end connections protected by a closed steel ring. A rotating field winding is, however, much safer to be manufactured than a rotating high-voltage winding and, therefore, the rotating armature has been generally given up. The inductor type of alternator seems to be very tempting for high-speed purposes, as all windings, the induced and inducing ones, are standing still and only

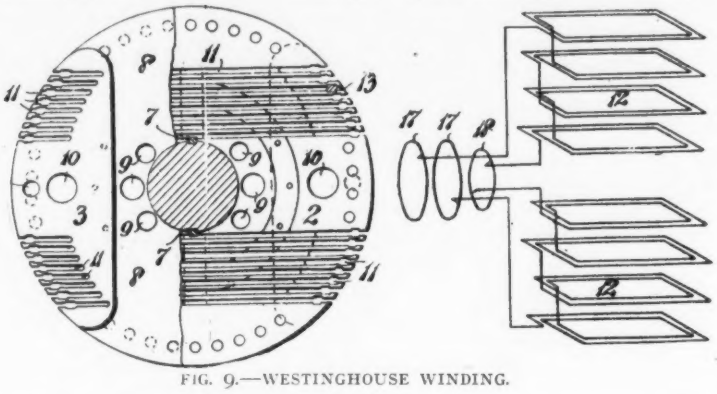


FIG. 9.—WESTINGHOUSE WINDING.

a simple steel wheel is rotating. In this type, however, the stray field losses and the iron losses, especially the eddy currents, are very considerable; the iron losses may even cause excessive heating.

Pole and pole shoes may form one piece with the yoke and hub (Figs. 8 to 10), which is perhaps the safest design. With definite poles usually either pole and pole pieces have together to be attached to the yoke by screws, dove-tails or wedges (Figs. 11 to 14 and Fig. 6), or the pole shoes are fixed in the same way on the pole projections, these being one piece, with the yoke (Figs. 15 to 17). In Fig. 18 (patent of the General Electric Company) sheet-iron bundles are

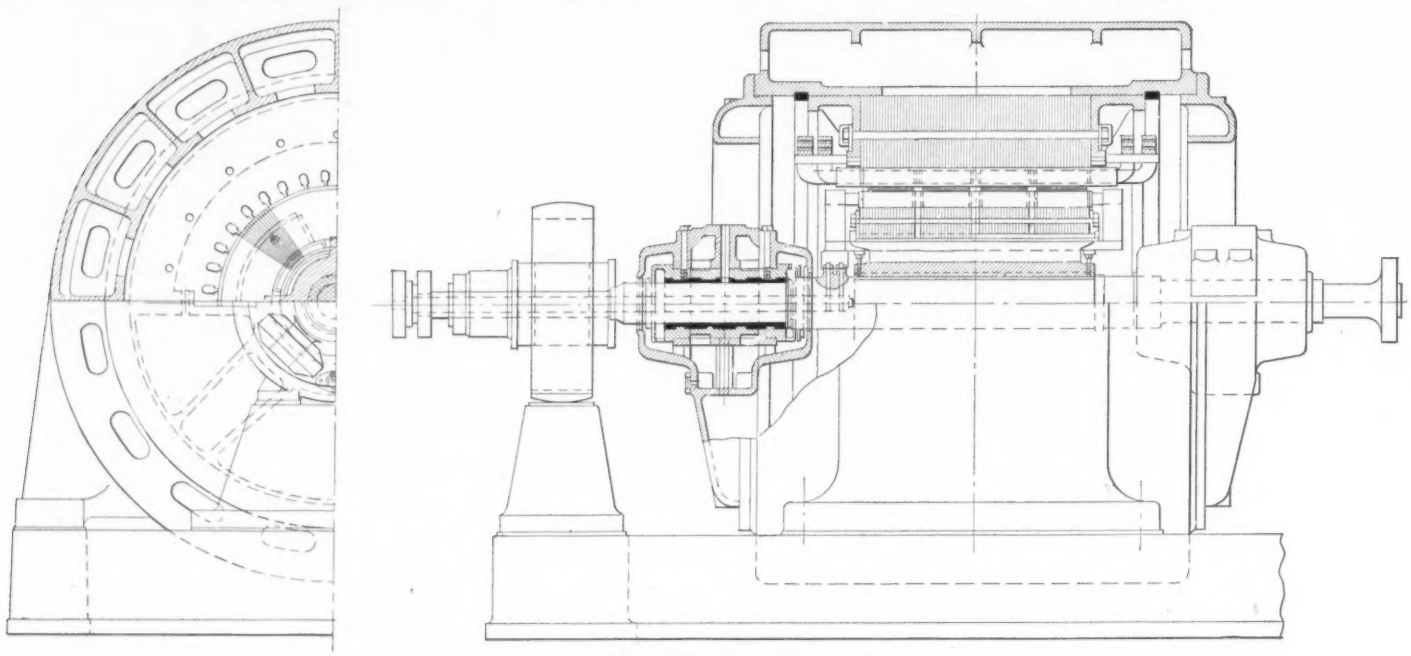


FIG. 10.—OERLIKON RING WINDING.

mortised in the hub by a wedge; the same design is also used for pole pieces.

To get an idea as to the strains in the various devices for attaching pole and pole pieces of high-speed fields, I take the following example from actual practice:

[2] Taken from Strecker; German translation of S. P. Thompson's "Dynamo-electric Machinery."

Four-pole, three-phase, u = 1,500 revolutions; circumferential speed = 100 meters per second; dimensions, according to Fig. 11; a = 25 cm., b = 4 cm., c' = 3 cm., h = 30 cm., axial pole length l = 30 cm.; the pole shoes are supposed not to overhang the poles in the axial direction, but on both sides by 5 cm.; copper strips on edge 0.5 × 5 cm. section, 50 turns per pole; rectangular pole shape.

	Weight	Centrifugal force in kilos
	in Kilos.	
One pole piece	27	45,000
One pole	180	180,000
One coil.	150	150,000

The various means for fixing poles and pole shoes have been chosen as strong as possible with regard to the existing pole section.

Fig. 11 diameter d of bolt = 8″; tensile stress

$$= \frac{375{,}000}{\frac{\pi}{20^2 \, — \, 4}} = 1{,}200 \text{ kg. per sq. cm.}$$

In Fig. 12 d can hardly be more than 6″, which means a still higher strain. Though these stresses are materially above the usual maximum in screw bolts, of 500 kg. per cm², in most cases, there still will not be sufficient space for the big nuts or screw heads inside the yoke. The tensile strain on two pieces of 3″ screws of Fig. 15 is

$$\frac{195{,}000}{\frac{\pi}{2 \times 1.5^2 — 4}} = 2{,}000 \text{ kg. per cm}^2;$$

in Fig. 16 with δ = 6″,

$$\frac{195{,}000}{\frac{\pi}{15^2 — 4}} = 1{,}100 \text{ kg. per. cm}^2.$$

Only the very best material can effectively withstand these stresses.

The dove-tails of Fig. 13 show with $a = b$ = 7 cm. a specific bending stress of

$$\frac{375{,}000 \, . \, a}{2 \times 2 \times \frac{1}{6} \, l \, b^2} = 2{,}700 \text{ kg. per cm}^2.$$

By choosing the angle of the dove-tail equal to 60° instead of 45, the value may be brought down somewhat. The section $c \times l$ (Fig. 13) has to bear a stretching strain of over 1,000 kg. per cm². if c = 100 cm. The shearing or transverse strain in the dove-tails is

$$\frac{375{,}000}{2 \, . \, bl} = 900 \text{ kg. per cm}^2.,$$

which must be combined in the well-known manner with the bending strain.

By replacing one dove-tail by two (Fig. 14) with $a = b$ = 3 cm., the strain just calculated becomes 3,200, 2,100, 1,800 kg. per cm²., and for the pole piece (Fig. 17) with a double dove-tail, 1,600, 1,100, 500 kg. per cm². The specific surface pressures in the dove-tail reach values as high as 1,000 kg. per cm². In the design (Fig. 18) with mortised bundles of 2 x 15 mm. thickness the wedge, F, with a section = 20 x 40 mm. has to withstand bending strains =

$$\frac{375{,}000 \times 1.5}{10 \times 8 \times \frac{1}{6} \times 4 \times 2^2} = 2{,}500 \text{ kg. per sq. cm.}$$

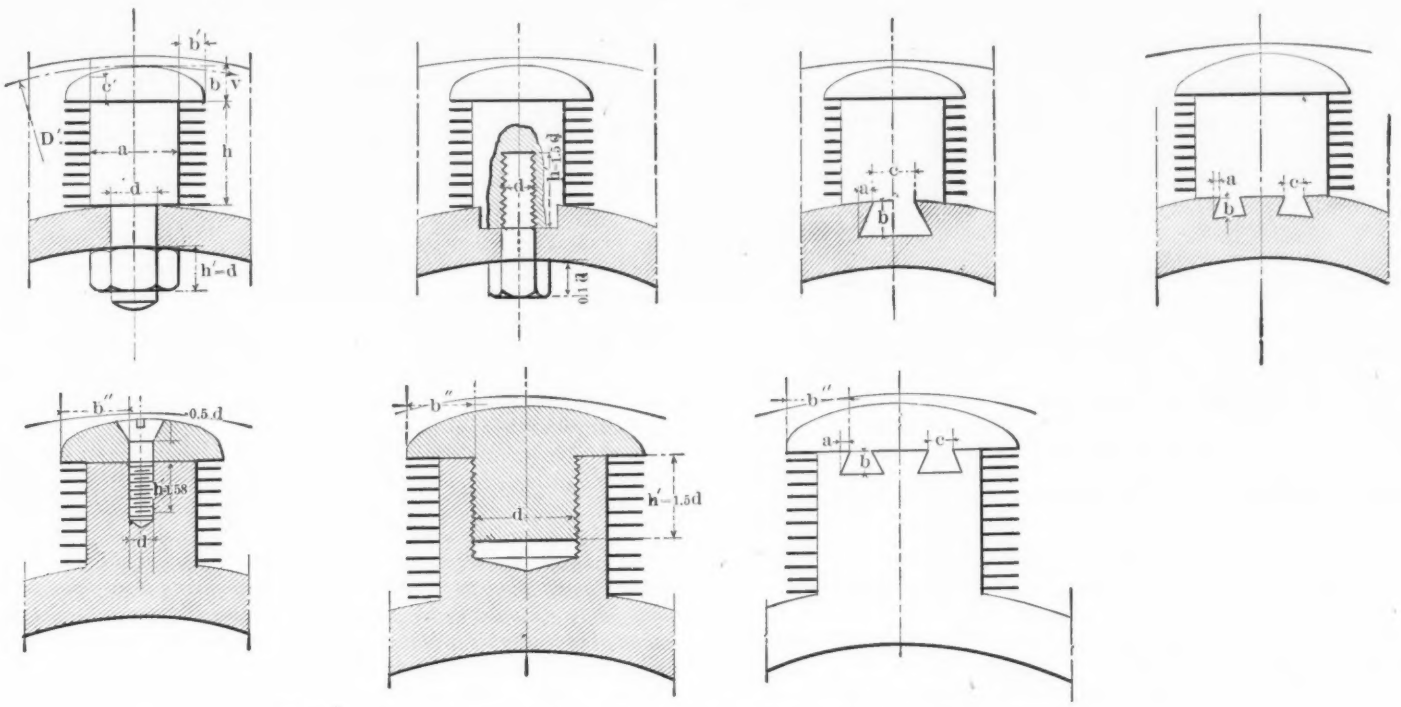
Similar calculations hold good for the design (Fig. 6). Of further importance are the bending pressures in the overhanging parts of pole pieces (Figs. 11 to 14) in the section c':

$$\frac{150{,}000 \; b'}{2 \times 2 \times \frac{1}{6} \, l \, . \, c'^2} = 4{,}000 \text{ kg. per sq. cm.}$$

In Figs. 15 to 17 these strains are still higher as b' is to be replaced by the larger value, b'' and 2 in the denominator by 1.5 or 1.

These examples may be sufficient to give an idea of the excessive strains which exist in high-speed field bodies.

4. Finally a few words about noiseless running. It is generally known that all extra high-speed machines have a certain tendency to produce a penetrating, shrill or droning noise, which renders every conversation impossible, and which may be heard over a great distance. The cause is the very rapid air movement, especially the whirls and sudden variations of the section of the streaming air by projecting and overhanging windings or other parts of the generator. Bars insufficiently fixed in the slots or laminated teeth not well



FIGS. 11 TO 17.—VARIOUS METHODS OF COMBINING POLES AND POLE SHOES.

pressed together may magnify the noise considerably. The best remedy consists in designing an absolutely smooth drum or rotating

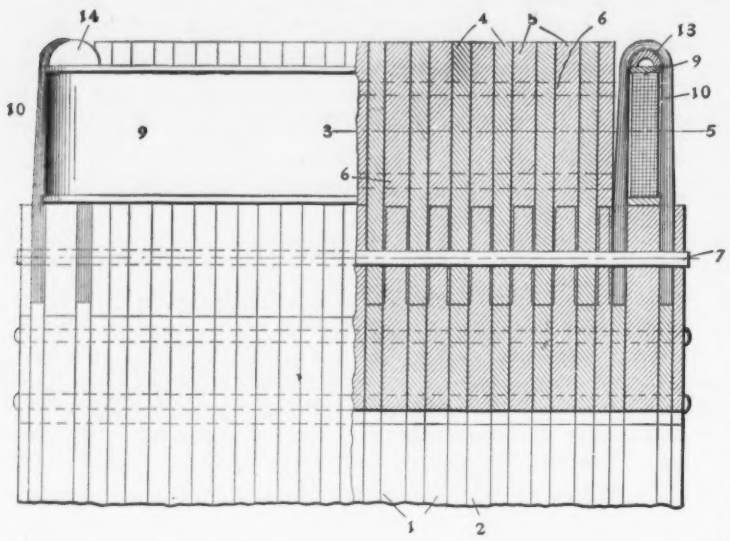


FIG. 18.—GENERAL ELECTRIC METHOD OF COMBINING POLES AND POLE SHOES.

part which can easily be done for the types of Figs. 9 and 10. Definite pole types have to be very often to be entirely closed by cylindrical

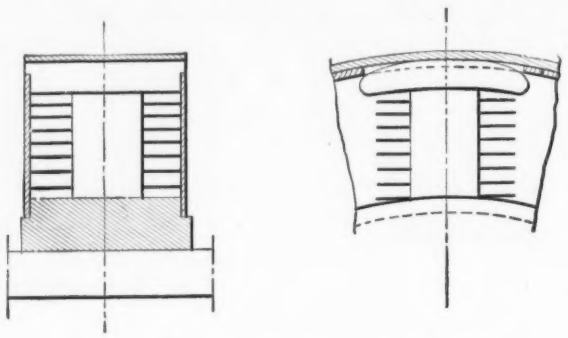


FIG. 19.—COMBINING POLES AND POLE SHOES.

and plain sheets (Figs. 8, 9 and 10), in which suitable air ducts and air holes have to be provided. All windings must be safely fixed by wedges and the teeth must be strengthened by solid end pieces.

New Telephone Company at Indianapolis.

The Indianapolis Telephone Company is the name of a new telephone company organized by the stockholders of the New Telephone Company with a purpose to lease and operate the exchanges and property of the New Telephone Company for a term of 20 years. The company will be incorporated and capitalized at $1,200,000.

The plans for the organization of the Indianapolis Telephone Company and the taking over, leasing and operating of the property of the New Telephone Company are very similar to those under which the Indianapolis Traction & Terminal and the Indiana Union Traction Companies were organized. The dividends on the stock and the interest on the bonds of the New Telephone Company, amounting in the aggregate to $64,000 annually, are guaranteed by the Indianapolis Telephone Company during the entire time of the lease.

The net income of the New Telephone Company last year was $110,000 and there are only 67 stockholders. These figures were given out by the officials for the first time this month. Under the new arrangements the net income will be increased at least $24,000 annually. The Indianapolis Telephone Company will realize $200,000 from stock, the greater part of which will be expended in making extensions so as to accommodate 3,000 more subscribers, 2,000 of whom already have their applications on file. The officers of the New Telephone Company have been elected to fill similar positions in the Indianapolis Telephone Company, viz.: S. P. Sheerin, president; Louis Holwegg, vice-president, and H. B. Sales, secretary and treasurer.

The Letter of Peregrinus on the Magnet, 1269.

THE following translation of this famous letter, to which we made a lengthy reference in our issue of March 11, is from the pen of Brother Arnold, M. Sc., Professor in Manhattan College, New York City. It was addressed by the author from the trenches at Nocera, Southern Italy, in August, 1269, to Sigerus de Foucaucourt, a countryman of his to whom he sought to explain the principle of his magnetic motor.

CHAPTER I.—PURPOSE OF THIS WORK.

DEAREST OF FRIENDS:—At your earnest request, I will now make known to you, in an unpolished narrative, the undoubted though hidden virtue of the lodestone, concerning which philosophers up to the present time give us no information, because it is characteristic of good things to be hidden in darkness until they are brought to light by application to public utility. Out of affection for you, I will write in a simple style about things entirely unknown to the ordinary individual. Nevertheless I will speak only of the manifest properties of the lodestone, because this tract will form part of a work on the construction of philosophical instruments. The disclosing of the hidden properties of this stone is like the art of the sculptor by which he brings figures and seals into existence. Although I may call the matters about which you inquire evident and of inestimable value, they are considered by common folk to be illusions and mere creations of the imagination. But the things that are hidden from the multitude will become clear to astrologers and students of nature and will constitute their delight as they will also be of great help to those that are old and more learned.

CHAPTER II.—QUALIFICATIONS OF THE EXPERIMENTER.

You must know, my dear friend, that whoever wishes to experiment, should be acquainted with the nature of things and should not be ignorant of the motion of the celestial bodies. He must also be skilful in manipulation in order that, by means of this stone, he may produce these marvelous effects. Through his own industry he can, to some extent indeed, correct the errors that a mathematician would inevitably make if he were lacking in dexterity. Besides, in such occult experimentation, great skill is required, for very frequently without it the desired result cannot be obtained, because there are many things in the domain of reason which demand this manual dexterity.

CHAPTER III.—CHARACTERISTICS OF A GOOD LODESTONE.

The lodestone selected must be distinguished by four marks—its color, homogeneity, weight and strength. Its color should be iron-like, pale, slightly bluish or indigo, just as polished iron becomes when exposed to the corroding atmosphere. I have never yet seen a stone of such description which did not produce wonderful effects. Such stones are found most frequently in northern countries, as is attested by sailors who frequent places on the northern seas, notably in Normandy, Flanders and Picardy. This stone should also be of homogeneous material; one having reddish spots and small holes in it should not be chosen; yet a lodestone is hardly ever found entirely free from such blemishes. On account of uniformity in its composition and the compactness of its innermost parts, such a stone is heavy and therefore more valuable. Its strength is known by its vigorous attraction for a large mass of iron; further on I will explain the nature of this attraction. If you chance to see a stone with all these characteristics, secure it if you can.

CHAPTER IV.—HOW TO DISTINGUISH THE PARTS OF A LODESTONE.

I wish to inform you that this stone bears in itself the likeness of the heavens, as I will now clearly demonstrate. There are in the heavens two points more important than all others, because on them, as on pivots, the celestial sphere revolves; these points are called one the arctic or north pole, the other the antarctic or south pole. Similarly you must fully realize that in this stone there are two points styled respectively the north pole and the south pole. If you are very careful, you can discover these two points in a general way. One method for doing so is the following: With an instrument with which crystals and other stones are rounded let a lodestone be made into a globe and then polished. A needle or an elongated piece of iron is then placed on top of the lodestone and a line is drawn in the direction of the needle or iron, thus dividing the stone into two equal parts. The needle is next placed on another part of the stone and a second median line drawn. If desired, this operation may be performed on many different parts, and undoubtedly all these lines will meet in two points just as all meridian or azimuth circles meet in the two opposite poles of the globe. One of these is the north

pole, the other the south pole. A proof of this will be found in subsequent chapters of this tract.

A second method for determining these important points is this: Note the place on the above-mentioned spherical lodestone where the point of the needle clings most frequently and most strongly; for this will be one of the poles as discovered by the previous method. In order to determine this point exactly, break off a small piece of the needle or iron so as to obtain a fragment about the length of two fingernails; then put it on the spot which was found to be the pole by the former operation. If the fragment stands perpendicular to the stone, then that is, unquestionably, the pole sought; if not, then move the iron fragment about until it becomes so; mark this point carefully; on the opposite end another point may be found in a similar manner. If all this has been done rightly, and if the stone is homogeneous throughout and a choice specimen, these two points will be diametrically opposite, like the poles of a sphere.

CHAPTER V.—HOW TO DISCOVER THE POLES OF A LODESTONE AND HOW TO TELL WHICH IS NORTH AND WHICH SOUTH.

The poles of a lodestone having been located in a general way, you will determine which is north and which south in the following manner: Take a wooden vessel rounded like a platter or dish, and in it place the stone in such a way that the two poles will be equidistant from the edge of the vessel; then place the dish in another and larger vessel full of water, so that the stone in the first-mentioned dish may be like a sailor in a boat. The second vessel should be of considerable size so that the first may resemble a ship floating in a river or on the sea. I insist upon the larger size of the second vessel in order that the natural tendency of the lodestone may not be impeded by contact of one vessel against the sides of the other. When the stone has been thus placed, it will turn the dish round until the north pole lies in the direction of the north pole of the heavens, and the south pole of the stone points to the south pole of the heavens. Even if the stone be moved a thousand times away from its position, it will return thereto a thousand times as by natural instinct. Since the north and the south parts of the heavens are known, these same points will then be easily recognized in the stone because each part of the lodestone will turn to the corresponding one of the heavens.

CHAPTER VI.—HOW ONE LODESTONE ATTRACTS ANOTHER.

When you have discovered the north and the south pole in your lodestone, mark them both carefully, so that by means of these indentations they may be distinguished whenever necessary. Should you wish to see how one lodestone attracts another, then, with two lodestones selected and prepared as mentioned in the preceding chapter, proceed as follows: Place one in its dish that it may float about as a sailor in a skiff, and let its poles which have already been determined be equidistant from the horizon, i. e., from the edge of the vessel. Taking the other stone in your hand, approach its north pole to the south pole of the lodestone floating in the vessel; the latter will follow the stone in your hand as if longing to cling to it. If, conversely, you bring the south end of the lodestone in your hand towards the north end of the floating lodestone, the same phenomenon will occur; namely, the floating lodestone will follow the one in your hand. Know then that this is the law: the north pole of one lodestone attracts the south pole of another, while the south pole attracts the north. Should you proceed otherwise and bring the north pole of one near the north pole of another, the one you hold in your hand will seem to put the floating one to flight. If the south pole of one is brought near the south pole of another, the same will happen. This is because the north pole of one seeks the south pole of the other, and therefore repels the north pole. A proof of this is that finally the north pole becomes united with the south pole. Likewise if the south pole is stretched out towards the south pole of the floating lodestone, you will observe the latter to be repelled, which does not occur, as said before, when the north pole is extended towards the south. Hence the silliness of certain persons is manifest, who claim that just as scammony attracts jaundice on account of a similarity between them, so one lodestone attracts another even more strongly than it does iron, a fact which they suppose to be false although really true as shown by experiment.

CHAPTER VII.—HOW IRON TOUCHED BY A LODESTONE TURNS TOWARDS THE POLES OF THE WORLD.

It is well known to all who have made the experiment, that when an elongated piece of iron has touched a lodestone and is then fastened to a light block of wood or to a straw and made float on water, one end will turn to the star which has been called the Sailor's star because it is near the pole; the truth is, however, that it does not point to the star but to the pole itself. A proof of this will be furnished in a following chapter. The other end of the iron will point in an opposite direction. But as to which end of the iron will turn towards the north and which to the south, you will observe that that part of the iron which has touched the south pole of the lodestone will point to the north and conversely, that part which had been in contact with the north pole will turn to the south. Though this appears marvelous to the uninitiated, yet it is known with certainty to those who have tried the experiment.

CHAPTER VIII.—HOW A LODESTONE ATTRACTS IRON.

If you wish the stone, according to its natural desire, to attract iron, proceed as follows: Mark the north end of the iron and towards this end approach the south pole of the stone, when it will be found to follow the latter. Or, on the contrary, to the south part of the iron present the north pole of the stone and the latter will attract it without any difficulty. Should you, however, do the opposite, namely, if you bring the north end of the stone towards the north pole of the iron, you will notice the iron turn round until its south pole unites with the north end of the lodestone. The same thing will occur when the south end of the lodestone is brought near the south pole of the iron. Should force be exerted at either pole, so that when the south pole of the iron which had been touched by the north end of the stone is made touch the south end of the stone, or else that part which had been in contact with the south pole is made touch the south pole of the stone, then the virtue in the iron will be easily altered in such a manner that what was before the south end will now become the north and conversely. The cause is that the last impression acts, confounds, or counteracts and alters the force of the original movement.

CHAPTER IX.—WHY THE NORTH POLE OF ONE LODESTONE ATTRACTS THE SOUTH POLE OF ANOTHER AND VICE VERSA.

As already stated, the north pole of one lodestone attracts the south pole of another and conversely; in this case the virtue of the stronger becomes active, whilst that of the weaker becomes obedient or passive. I consider the following to be the cause of this phenomenon: the active agent requires a passive subject, not merely to be joined to it, but also to be united with it, so that the two make but one by nature. In the case of this wonderful lodestone this may be shown in the following manner: Take a lodestone which you may call *A D*, in which *A* is the north pole and *D* the south; cut this stone into two parts, so that you may have two distinct stones; place the stone having the pole *A* so that it may float on water and you will observe that *A* turns towards the north as before; the breaking did not destroy the properties of the parts of the stone, since it is homogeneous; hence it follows that the part of the stone at the point of fracture, which may be marked *B*, must be a south pole; this broken part of which we are now speaking may be called *A B*. The other, which contains *D*, should then be placed so as to float on water, when you will see D point towards the south because it is a south pole; but the other end at the point of fracture, lettered *C*, will be a north pole; this stone may now be named *C D*. If we consider the first stone as the active agent, then the second, or *C D*, will be the passive subject. You will also notice that the ends of the two stones which before their separation were together, after breaking will become one a north pole and the other a south pole. If now these same broken portions are brought near each other, one will attract the other, so that they will again be joined at the points *B* and *C*, where the fracture occurred. Thus, by natural instinct, one single stone will be formed as before. This may be demonstrated fully by cementing the parts together, when the same effects will be produced as before the stone was broken. As you will perceive from this experiment the active agent desires to become one with the passive subject because of the similarity that exists between them. Hence, *C* being a north pole must be brought close to *B* so that the agent and its subject may form one and the same straight line in the order *A B*, *C D* and *B* and *C* being at the same point. In this union, the identity of the extreme parts is retained and preserved just as they were at first; for *A* is the north pole in the entire line as it was in the divided one; so also *D* is the south pole, as it was in the divided passive subject, but *B* and *C* have been made effectually into one. In the same way it happens that if *A* be joined to *D* so as to make the two lines one, in virtue of this union due to attraction in the order *C D A B*, then *A* and *D* will constitute but one point, the identity of the extreme parts will remain unchanged just as they were before being brought together, for *C* is a north pole and *B* a south,

as during their separation. If you proceed in a different fashion, this identity or similarity of parts will not be preserved; for you will perceive that if *C*, a north pole, be joined to *A*, a north pole, contrary to the demonstrated truth, and from these two lines a single one, *B A C D*, is formed, as *D* was a south pole before the parts were united, it is then necessary that the other extremity should be a north pole, and as *B* is a south pole, the identity of the parts of the former similarity is destroyed. If you make *B* the south pole as it was before they united, then *D* must become north though it was south in the original stone; in this way neither the identity nor similarity of parts is preserved. It is becoming that when the two are united into one, they should bear the same likeness as the agent, otherwise nature would be called upon to do what is impossible. The same incongruity would occur if you were to join *B* with *D* so as to make the line *A B C D*, as is plain to any person who reflects a moment. Nature therefore aims at being and also at acting in the best manner possible; it selects the former motion and order rather than the second because the identity is better preserved. From all this it is evident why the north pole attracts the south and conversely, as also why the south pole does not attract the south pole and the north pole does not attract the north.

CHAPTER X.—AN INQUIRY INTO THE CAUSE OF THE NATURAL VIRTUE OF THE LODESTONE.

Certain persons who were but poor investigators of nature held the opinion that the force with which a lodestone draws iron, is found in the mineral veins themselves from which the stone is obtained; whence they claim that the iron turns towards the poles of the earth, only because of the numerous iron mines found there. But such persons are ignorant of the fact that in many different parts of the globe the lodestone is found; from which it would follow that it should turn in different directions according to the locality; but this is contrary to experience. Secondly, these individuals do not seem to know that the places under the poles are uninhabitable because there one-half the year is day and the other half night. Hence it is most silly to imagine that the lodestone should come to us from such places. Since the lodestone points to the south as well as to the north, it is evident from the foregoing chapters that we must conclude that not only from the north pole but also from the south pole rather than from the veins of the mines virtue flows into the poles of the lodestone. This follows from the consideration that wherever a man may be, he finds the stone pointing to the heavens in accordance with the position of the meridian; but all meridians meet at the poles of the world; hence it is manifest that from the poles of the world, the poles of the lodestone receive their virtue. Another necessary consequence of this is that the needle does not point to the pole star, since the meridians do not intersect in that star but in the poles of the earth. In every region, the pole star is always found outside the meridian except twice in each complete revolution of the heavens. From all these considerations, it is clear that the poles of the lodestone derive their virtue from the poles of the heavens. As regards the other parts of the stone, the right conclusion is, that they obtain their virtue from the other parts of the heavens, so that we may infer that not only the poles of the stone receive their virtue and influence from the poles of the world, but also likewise the other parts, or the entire stone from the entire heavens. You may test this in the following manner: A round lodestone on which the poles are marked is placed on two sharp styles as pivots having one pivot under each pole so that the lodestone may easily revolve on these pivots. Having done this, make sure that it is equally balanced and that it turns smoothly on the pivots. Repeat this several times at different hours of the day and always with the utmost care. Then place the stone with its axis in the meridian, the poles resting on the pivots. Let it be moved after the manner of bracelets so that the elevation and depression of the poles may equal the elevation and depression of the poles of the heavens of the place in which you are experimenting. If now the stone be moved according to the motion of the heavens, you will be delighted in having discovered such a wonderful secret; but if not, ascribe the failure to your own lack of skill rather than to a defect in nature. Moreover, in this position I consider the strength of the lodestone to be best preserved. When it is placed differently, i. e., not in the meridian, I think its virtue is weakened or obscured rather than maintained. With such an instrument you will need no timepiece, for by it you can know the ascendant at any hour you please, as well as all other dispositions of the heavens which are sought for by astrologers.

PART II.

CHAPTER I.—THE CONSTRUCTION OF AN INSTRUMENT FOR MEASURING THE AZIMUTH OF THE SUN, THE MOON OR ANY STAR ON THE HORIZON.

Having fully examined all the properties of the lodestone and the phenomena connected therewith, let us now come to those instruments which depend for their operation on the knowledge of those facts. Take a rounded lodestone and after determining its poles in the manner already mentioned, file its two sides so that it becomes elongated at its poles and occupies less space. The lodestone prepared in this wise is then enclosed within two capsules after the fashion of a mirror. Let these capsules be so joined together that they cannot be separated and that water cannot enter; they should be made of light wood and fastened with cement suited to the purpose. Having done this, place them in a large vessel of water on the edges of which the two parts of the world, i. e., the north and south points, have been found and marked. These points may be united by a thread stretched across from north to south. Then float the capsules and place a smooth strip of wood over them in the manner of a diameter. Move the strip until it is equally distant from the meridian-line previously determined and marked by a thread, or

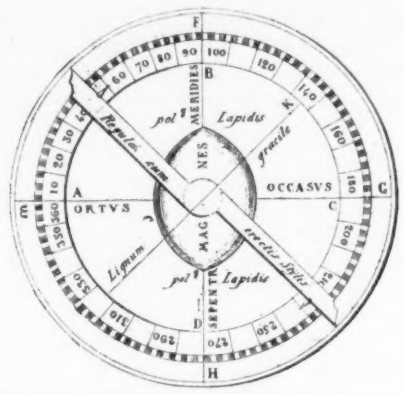


FIG. I.—AZIMUTH COMPASS OF PEREGRINUS.

else until it coincides therewith. Then mark a line on the capsules according to the position of the strip and this will indicate forever the meridian of that place. Let this line be divided at its middle by another cutting it at right angles which will give the east and west line; thus the four cardinal points will be determined and indicated on the edge of the capsules. Each quarter is to be subdivided into 90 parts, making 360 in the circumference of the capsules. Engrave these divisions on them as usually done on the back of an astrolabe. On the top or edge of the capsules thus marked, place a thin ruler like the pointer on the back of the astrolabe; instead of the sights attach two perpendicular pins, one at each end. If, therefore, you desire to take the azimuth of the sun, place the capsules in water and let them move freely until they come to rest in their proper position. Hold them firmly in one hand, while with the other you move the ruler until the shadow of the pins falls along the length of the ruler; then the end of the ruler which is towards the sun will indicate the azimuth of the sun. Should it be windy, let the capsules be covered with a suitable vessel until they have taken their position north and south. The same method, namely, by sighting, may be followed at night for determining the azimuth of the moon and stars; move the ruler until the ends of the pins are in the same line with the moon or star; the end of the ruler will then indicate the azimuth just as in the case of the sun. By means of the azimuth may then be determined the hour of the day, the ascendant, and all those other things usually determined by the astrolabe. A form of the instrument is shown in the following figure. (See Fig. 1.)

CHAPTER II.—THE CONSTRUCTION OF A BETTER INSTRUMENT FOR THE SAME PURPOSE.

In this chapter I will describe the construction of a better and more efficient instrument. Select a vessel of wood, brass or any solid material you like, circular in shape, moderate in size, shallow but of sufficient width, with a cover of some transparent substance, such as glass or crystal; it would be even better to have both the vessel and the cover transparent. At the center of this vessel fasten a thin axis of brass or silver, having its extremities in the cover above and the vessel below. At the middle of this axis, let there be two apertures at right angles to each other; through one of them pass an iron stylus or needle, through the other a silver or brass

needle crossing the iron one at right angles. Divide the cover first into four parts and subdivide these into 90 parts, as was mentioned in describing the former instrument. Mark the parts north, south, east, and west. Add thereto a ruler of transparent material with pins at each end. After this bring either the north or the south pole of a lodestone near the cover so that the needle may be attracted and receive its virtue from the lodestone. Then turn the vessel until the needle stands in the north and south line already marked on the instrument; after which turn the ruler towards the sun if day-time, and towards the moon and stars at night, as described in the preceding chapter. By means of this instrument you can direct your course towards cities and islands and any other place wherever you may wish to go by land or sea, provided the latitude and longitude of the places are known to you. How iron remains suspended in air by virtue of the lodestone, I will explain in my book on the action of mirrors. Such, then, is the description of an instrument depending on the above-mentioned stone as depicted below. (See Fig. 2.)

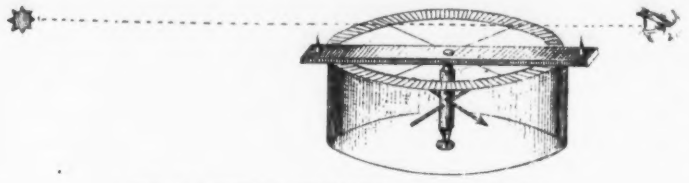


FIG. 2.—PIVOTED COMPASS OF PEREGRINUS.

CHAPTER III.—THE ART OF MAKING A WHEEL OF PERPETUAL MOTION.

In this chapter I will make known to you the construction of a wheel which in a remarkable manner moves continuously. I have seen many persons vainly busy themselves and even becoming exhausted with much labor in their endeavors to invent such a wheel.

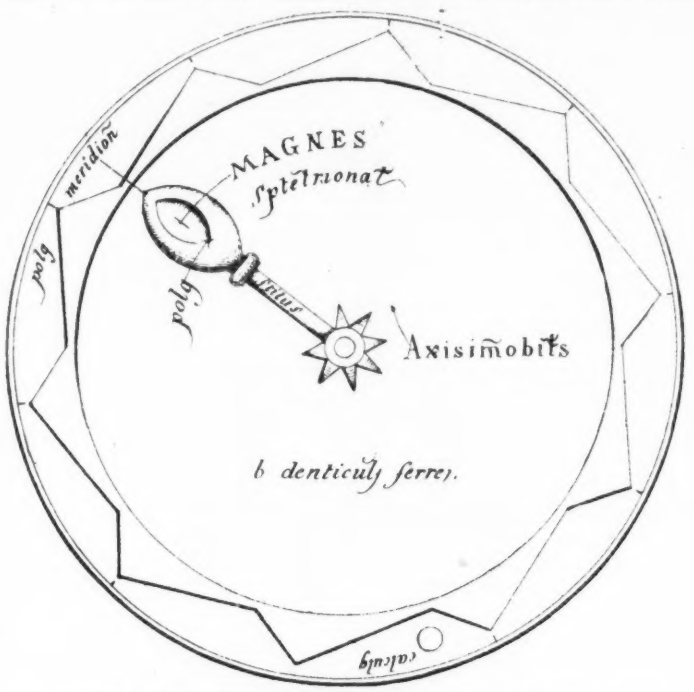


FIG. 3.—THE CONTINUOUSLY-MOVING WHEEL, OR MAGNETIC MOTOR, OF PEREGRINUS.

But these invariably failed to notice that by means of the virtue or power of this stone all difficulty can be overcome. For the construction of such a wheel, take a silver capsule like that of a concave mirror, and worked on the outside with fine carving and perforations, not only for the sake of beauty but also the purpose of diminishing its weight. You should manage also that the eye of the unskilled may not perceive what is cunningly placed inside. Within let there be iron nails or teeth of equal weight fastened to the periphery of the wheel in a slanting direction, close to one another so that their distance apart may not be more than the thickness of a bean or a pea; the wheel itself must be of uniform weight throughout. Fasten the middle of the axis about which the wheel revolves so that the said axis may always remain immovable. Add thereto a silver bar and at its extremity affix a lodestone placed between two capsules and prepared in the following way: When it has been rounded and its poles marked as said before, let it be shaped like an egg; leaving the poles untouched, file down the intervening parts so that thus flattened and occupying less space, it may not touch the sides of the capsules when the wheel revolves. Thus prepared, let it be affixed to the silver rod just as a precious stone is placed in a ring; let the north pole be then turned towards the teeth or cogs of the wheel somewhat slantingly so that the virtue of the stone may not flow diametrically into the iron teeth but at a certain angle; consequently when one of the teeth comes near the north pole and owing to the impetus of the wheel passes it, it then approaches the south pole from which it is rather driven away than attracted, as is evident from the law given in a preceding chapter. Therefore such a tooth would be constantly attracted and constantly repelled. In order that the wheel may do its work more speedily, place within the box a small rounded weight made of brass or silver of such a size that it may be caught between each pair of teeth; consequently as the movement of the wheel is continuous in one direction, so the fall of the weight will be continuous in the other. Being caught between the teeth of a wheel which is continuously revolving, it seeks the center of the earth in virtue of its own weight, thereby aiding the motion of the teeth and preventing them from coming to rest in a direct line with the lodestone. Let the places between the teeth be suitably hollowed out so that they may easily catch the body in its fall, as shown in the diagram below. (See Fig. 3.)

Farewell: finished in camp at the siege of Lucera on the eighth day of August, Anno Domini MCCLXIX.*

Telegrams and Cables in War.

The following reply, inspired by the Foreign Office, to Japan's rejoinder to the Russian protest against the violation of Corean neutrality, has been issued in St. Petersburg and is apparently intended to be accepted as official:

Japan's argument that she was justified in landing troops in Corea before the declaration of war because she had Corea's permission, and also that these troops arrived in Corea after "the existence of a state of war," is without value, as Corea in January promulgated her neutrality to the Powers, which received it warmly, Great Britain even officially conveying expressions of gratitude to the Corean Government. Therefore, no state of war gave the Japanese the right to violate her neutrality by landing troops in her territory. Even the consent of Corea, though extorted by the Japanese, is without force, from the fact that the dispatch of troops was not only before the war, but before the breaking off of diplomatic relations, as clearly established and indeed acknowledged by the Japanese themselves.

Japan's contention in defence of the attack on the Russian ships at Chemulpo, that the port was not neutral on February 9, is false, again because Corea had proclaimed her neutrality. Japan's denial of malicious interference with the transmission of Russian telegrams over the Danish cable cannot be sustained. A telegram to Baron de Rosen (then Russian minister to Japan), at Tokio, sent from St. Petersburg February 4, was not delivered till the morning of February 7. That delay did not occur on the Siberian line, as was shown by the fact that a reply to a telegram from Viceroy Alexieff sent at the same time was received the same day. Therefore, it is conclusive that the De Rosen telegram was held by the Japanese and not delivered for two days.

Communication with M. Pavloff (then Russian minister to Corea) by the Corean telegraph ceased in the middle of January. As the Coreans were enjoying friendly relations with Russia, there is good ground for believing that the interruption was due to the Japanese. Thereafter M. Pavloff used a mail steamer or a special warship to communicate with Port Arthur. The minister of Russia at Seoul February 8, therefore, knew nothing of the diplomatic rupture.

Japan pleads that the charge against her seizure of Russian merchantmen before the declaration of war cannot lie after the establishment of prize courts. Their seizure before the declaration of war being piracy is not defensible by the establishment of prize courts, which cannot exist before a declaration of war. The steamer *Russia* was seized in the waters of southern Corea even before M. Kurino had presented his note here.

The reply concludes: "Our information regarding Japan's announcement that in future Corea would be under her administration came from M. Pavloff and also from the representative of a friendly power at Seoul. Japan's denial, consequently, is fruitless, as also is

*This farewell sentence is in most MSS., but is not in Gasser's printed edition of the letter, 1558.

the attempt to refute our statement that the Russian minister and consul at Seoul were told to leave. We had conclusive proof in St. Petersburg on February 10 that the French minister at Seoul had officially notified our representatives that the Japanese Government had intimated that they should leave, and that the Japanese had occupied territory in Corea. M. Pavloff was unable to notify our consul at Fusan, his telegram being refused at the telegraph office."

A Metrical Detector for Electric Waves.

By L. HEATHCOTE WALTER, M. A.

THE want of a satisfactory metrical detector of electrical oscillations has so often been pointed out that a description of the new oscillation galvanometer, which I have designed in conjunction with Prof. J. A. Ewing, F.R.S., will probably be of interest.

This instrument differs from any of the detectors hitherto invented, in that the oscillations directly and visibly indicate their presence by a mechanical movement proportional to their intensity, as a galvanometer responds to a continuous current, and in that such

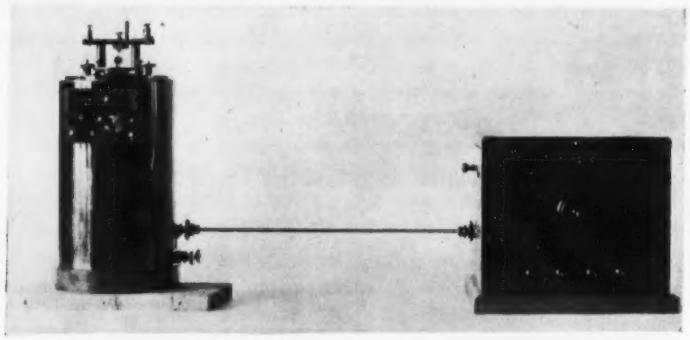


FIG. 1.—WAVE DETECTOR COMPLETE.

quantitative readings can be directly obtained over a practically unlimited range without any alteration to the aerial wires or other conducting masses used to pick up the waves.

Prof. Fessenden some time ago pointed out the impossibility of obtaining a direct mechanical movement from the oscillations, owing to their extremely high frequency. By using an extraneous source (a rotating field) to supply the energy, and making use of the novel property which I discovered—that by passing such oscillations along a magnetic wire, itself subjected to a rotating magnetic field, the hysteresis is enormously *increased,* the effect of the oscillations being to permit more of this externally supplied energy to be utilized—this difficulty is overcome, the same effect being obtained, and to a vastly increased extent, as if the direct electro-dynamic effects of the oscillations were made use of. The instrument depends, as before stated, upon the increase of hysteresis (in the sense of work done per reversal) produced in a bobbin of steel wire, placed in a rotating field,

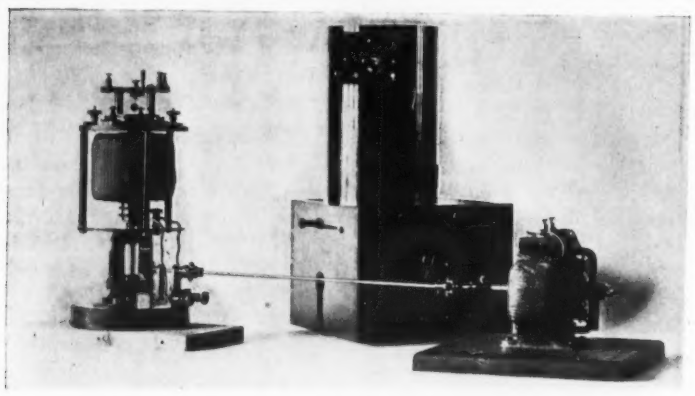


FIG. 2.—DETECTOR WITH COVERS REMOVED.

when oscillations are passed through the wire itself, such oscillations producing an oscillatory circular magnetism superimposed on the varying longitudinal magnetization. The principle and the preliminary experiments leading up to the design of the present instrument are described in a paper by Dr. Ewing and myself on "A New Method of Detecting Electrical Oscillations," read before the Royal Society, London, England, on February 11, 1904.

Briefly, the instrument is an adaptation of the Ewing hysteresis tester, in this case the specimen being held fast and the magnetic field revolving, being driven by an electric motor. The bobbin, which is supported on pivots in jewels, is prevented from following the field by means of a controlling spring. The winding on the bobbin is made as nearly non-inductive as possible by being double-wound, and consists of a number of turns of very fine insulated steel wire, the plane of the turns being at right angles to the axis of the bobbin. The bobbin is immersed in petroleum or thicker mineral oil, according to the amount of damping required, the oil also serving to steady the deflection and to improve the insulation. The instrument has to be considered from two standpoints, the requirements of which are somewhat different. Thus for physical measurements and metrical purposes generally, the instrument is provided with a permanent magnet system for the field, and readings are taken by spot and scale, a mirror being fixed on the bobbin axis. When the apparatus is working there is a steady deflection due to the normal hysteresis, and the spot can be set with the zero at any part of the scale. On oscillations arriving, the bobbin gives a throw in the same direction as that due to the normal hysteresis (same direction as the field), returning to the normal position as soon as the oscillations cease.

The sensibility of the instrument can be made anything desired, firstly, by suitable proportions being given to the bobbin and the wire winding. Thus for measurements near a spark coil, a very small bobbin and short length of wire of larger diameter and lower resistance will suffice, and such wire can be more highly insulated. For other purposes where a low resistance may be desirable, the instrument can be equipped with a bobbin provided with a copper primary of low resistance, either on the bobbin itself or as a fixture external to it, through which the oscillations are to pass, acting inductively on the magnetic winding, which in such a case must be inductively wound and closed on itself; several modifications of such windings are shown in the specification of United States Patent No. 741,570, so that it is unnecessary to describe them. An instrument provided with a bobbin of the highest sensibility can, however, be

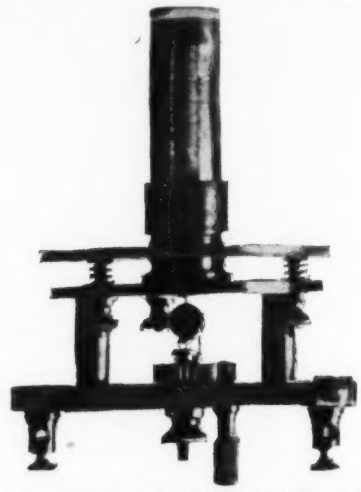


FIG. 3.—VIEW OF THE BOBBIN IN ITS CELL.

used for such measurements if a shunt circuit is employed, and in such a case a sensibility of the order of an average coherer is attainable.

For a receiver for wireless telegraphy, the requirements are somewhat different; sensitiveness (within limits) and rapidity of action being the dominating requirements. Any type of recording apparatus can be actuated by means of the bobbin, a syphon recording attachment having been so employed with good results. That is, however, merely a case of mechanical adaptation, such a possibility being self-evident. The oscillations used for this purpose are also of much greater wave length, necessitating, in the case of simple direct excitation connection (for the best results) the use of a more considerable length of wire on the bobbin. When using a transformer or a shunt connection the conditions are different. I hope shortly to be able to publish the results of experiments in this connection. The figures show one type of the instrument in which an electromagnet furnishes the revolving field. In Fig. 1 the complete instrument is seen. In Fig. 2 the outer covers are removed, to show the magnet system and the interior of the motor box. Fig. 3 shows the bobbin in its cell.

Calculation of the Equivalent Ampere-Turns of Windings for Single and Polyphase Currents.—III.

(*Concluded.*)

BY C. F. GUILBERT.

NEXT let us examine the case when u is an odd number. As is shown in Figs. 9 and 10, the law of distribution of the m.m.f. is then the same for all the poles. It is to be seen that as in the analogous case of separate phase windings, the coil having a width equal to the pole step a, should be considered for each pole as having half the number of turns as the others; that is to say, $\frac{N}{2u}$ instead of $\frac{N}{u}$. The peripheral widths, b, of the successive and concentric coils are thus:

$$a, \quad \frac{a}{\pi}\left(\pi - 2\frac{2\pi}{qu}\right), \quad \frac{a}{\pi}\left(\pi - 2\frac{4\pi}{qu}\right), \quad \ldots \ldots \frac{a}{\pi}\left(\pi - 2(u-1)\frac{\pi}{qu}\right)$$

which correspond for the quantity, $\frac{b}{a}\frac{\pi}{2}$, to the values

$$\frac{\pi}{2}, \quad \frac{\pi}{2}\cdot\frac{2\pi}{qu}, \quad \frac{\pi}{2}\cdot 2\frac{2\pi}{qu}, \quad \ldots \quad \frac{\pi}{2}\cdot\frac{u-1}{2}\frac{2\pi}{qu}$$

The total m.m.f. per pole of the phase considered is then, taking account of the remark made with respect to the first coil.

$$\mathfrak{F}_i = \frac{4}{\pi^2}\frac{NI\sqrt{2}}{2u}\left[1 + 2\left(\cos\frac{2\pi}{qu} + \cos 2\frac{2\pi}{qu} + \ldots \ldots + \cos\frac{u-1}{2}\frac{2\pi}{qu}\right)\right]$$

This expression is analogous to that which has already been obtained above for the case of separate phases; the number of turns is the same and the only difference consists in that the ratio of the progression of the arcs is double; that is to say, $\frac{2\pi}{qu}$ instead of $\frac{\pi}{qu}$. The desired result may then be obtained simply by replacing in the expression found above, q by $\frac{q}{2}$, in such a manner as to double the ratio. The expression for $\mathfrak{F}'$ is then, for q phases,

$$\mathfrak{F}_i' = q\frac{2}{\pi^2}\frac{\sin\frac{\pi}{q}}{u\sin\frac{\pi}{qu}}$$

Unlike in the case of separate phase windings, the formula for calculating the equivalent m.m.f. is different for an even and odd number of slots per pole and per phase. This, however, is the only divergence.

As has been done in the case when u is even, it is interesting to compare this formula with that which corresponds to the case where the phases are not superposed. The two formulas differ only by the two quantities:

$$\frac{\sin\frac{\pi}{2q}}{u\sin\frac{\pi}{2qu}} \quad \text{and} \quad \frac{\sin\frac{\pi}{q}}{u\sin\frac{\pi}{qu}},$$

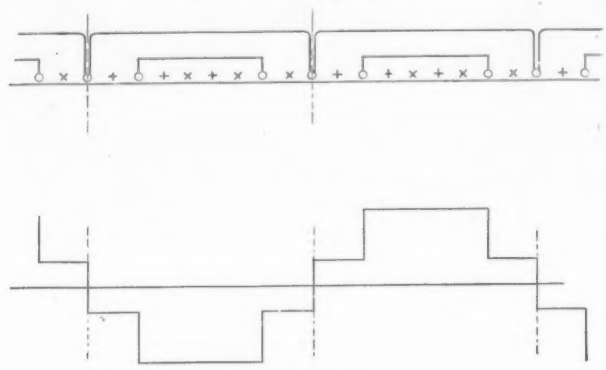
which reduce for large values of u to

$$\frac{2q}{\pi}\sin\frac{\pi}{2q} \quad \text{and} \quad \frac{q}{\pi}\sin\frac{\pi}{q}.$$

For the case of three-phase windings the values of these quantities are, for the factor $\frac{3}{\pi}$, 1 and 0.866, which leads to a difference identical to that corresponding to the case where u is even.

M.M.F. OF SUPERPOSED PHASE WINDING WITH COMMON SLOTS.

We finally come to the case where each slot contains the conductors of the two phases in equal number. As previously, several cases may present themselves, but first it is desirable to define what

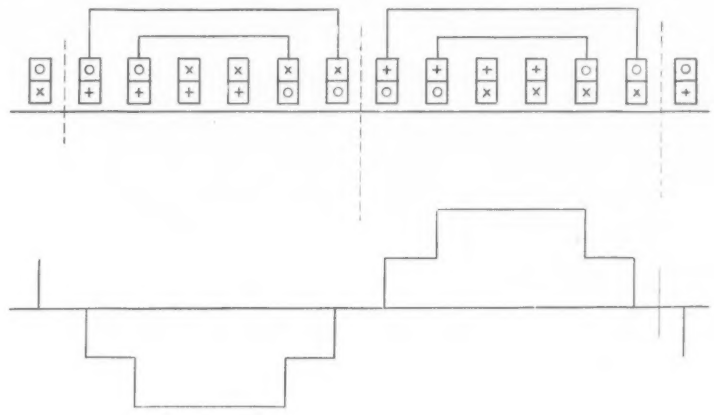


FIGS. 9 AND 10.

should be understood by u in order to obtain formulas comparable to those already established.

We will designate this time by $2u$, the number of slots per pole containing conductors of the same phase, so that the actual distance of two slots referred to the case of a bipolar machine will remain $\frac{\pi}{qu}$, u thus representing here the half number of slots corresponding per pole to a single phase. It is evident that since the number of slots, $2u$ per pole per phase, is always even whether u is odd or even, we can always form per pole a certain number of coils having the same number of turns. Thus one formula can be established for all values of u.

Take, for example, the case where u is even. It will be seen by Figs. 11 and 12 that we can form for each pole identical coils, giving rise consequently to the same law of distribution for all the poles.



FIGS. 11 AND 12.

The widths b of elementary coils have for value,

$$\frac{a}{\pi}\left(\pi-\frac{\pi}{q\,u}\right),\ \frac{a}{\pi}\left(\pi-3\,\frac{\pi}{q\,u}\right)\ \ldots\ldots$$

$$\frac{a}{\pi}\left(\pi-(2\,u-1)\,\frac{\pi}{q\,u}\right)$$

Applying the formula giving the m.m.f. of a single coil, bearing in mind that the number of turns for each elementary coil is here $\frac{N}{2\,u}$, if N is always the number of conductors per pole per phase, we will have in making summation for all the coils of the same phase,

$$\mathfrak{F}_i' = \frac{4}{\pi^2}\,\frac{NI\sqrt{2}}{2\,u}\left[\cos\frac{\pi}{2\,q\,u}+\cos\frac{3\,\pi}{2\,q\,u}+\ \ldots\ \cos(2\,u-1)\,\frac{\pi}{2\,q\,u}\right]$$

This expression is identical with that obtained for the case of superposed windings having the same number of slots per pole, but where each slot contains only the conductors of a single phase. The expression for the equivalent m.m.f. of the entire windings will then again be

$$\mathfrak{F}_i = q\,\frac{2}{\pi^2}\,\frac{\sin\frac{\pi}{q}}{2\,u\,\sin\frac{\pi}{2\,q\,u}}\,NI\sqrt{2}.$$

This formula thus applies to all cases where the phases are superposed except for an odd number of slots per pole. In this latter case alone the distribution of the instantaneous m.m.f. is not the same at two neighboring poles.

In what precedes we have taken for granted that each pole comprises an entire number of slots; or in other words, that the total number of slots is a multiple of the number of poles. This is true only for looped or series-parallel windings having a number of circuits in parallel equal to or a multiple of the number of poles. Consequently, the formulas are not rigorously exact in the case of alternators and asynchronous motors as usually wound. However, since an exact calculation would lead to expressions too complicated for practical use, the two general formulas deduced can be adapted for separate phase windings and superposed windings by leaving aside the case of an odd number of slots per pole and per phase. It suffices for this purpose to transform them by introducing the total number of slots of the machine, $u_1 = 2\,p\,q\,u$, $2\,p$ being the number of poles and b the total number of conductors per phase, $N_1 + 2\,p\,N$. The expression for the equivalent m.m.f. of windings by distinct phases thus becomes

$$\mathfrak{F}_i = q\,\frac{2}{\pi^2}\,\frac{\sin\frac{\pi}{2\,q}}{2\,q\,p\,u\,\sin\frac{p\,\pi}{2\,q\,p\,u}}\,2\,q\,p\,NI\sqrt{2}$$

$$=\frac{1}{\pi^2}\,q^2\,\frac{\sin\frac{\pi}{2\,q}}{u_1\,\sin\frac{p\,\pi}{u_1}}\,N_1 I\sqrt{2}$$

and that for the equivalent m.m.f. of the superposed phase winding becomes

$$\mathfrak{F}_i = q\,\frac{2}{\pi^2}\,\frac{\sin\frac{\pi}{q}}{2\,q\,p\,u\,\sin\frac{p\,\pi}{2\,q\,p\,u}}\,q\,p\,NI\sqrt{2}$$

$$=\frac{2}{n^2}\,q^2\,\frac{\sin\frac{\pi}{q}}{u_1\,\sin\frac{q\,\pi}{u_1}}\,N_1 I\sqrt{2}.$$

The formulas which give the equivalent ampere-turns per pole of a polyphase winding traversed by alternating currents with an effective value, I, can be combined in a single formula,

$$\mathfrak{F}_i = \frac{q}{2}\,K\,N\,I\,\sqrt{2}.$$

in assuming with Prof. Blondel that $K = \left(\frac{2}{\pi}\right)^2 k$,

where k can take the following values:

$$k = \frac{\sin\frac{\pi}{2\,q}}{u\,\sin\frac{\pi}{2\,q\,u}}.$$ Separate phase winding;

$$k = \frac{\sin\frac{\pi}{q}}{2\,u\,\sin\frac{\pi}{2\,q\,u}}.$$ Superposed phase winding, u even;

$$k = \frac{\sin\frac{\pi}{q}}{u\,\sin\frac{\pi}{2\,q\,u}}.$$ Superposed phase winding, u odd;

It is only to be remarked that the factors k are none other than the reduction factors of the induced e.m.f. permitting account to be taken of the distribution of the conductors of the same phase in several slots per pole.

Together with the exact formulas preceding we can finally employ the following approximate formula in the case where the number of slots corresponding to each pole is not a whole number:

$$\mathfrak{F}_i = \frac{q}{2}\left(\frac{2}{\pi}\right)^2 k\,N_1 I\,\sqrt{2},$$

when k can have the values

$$k = \frac{q\,\sin\frac{\pi}{2\,q}}{u_1\,\sin\frac{p\,\pi}{u_1}}.$$ Separate phase winding;

$$k = \frac{q\,\sin\frac{\pi}{q}}{2\,u_1\,\sin\frac{p\,\pi}{u_1}}.$$ Superposed phase winding.

These formulas naturally contain the preceding except that corresponding to the case where u is odd and the winding is of the superposed phase type. They are very convenient for application in all cases and may be found of much service in the calculation of alternators and asynchronous motors.

The Telephone Substation.—I.

BY ARTHUR V. ABBOTT, C. E.

INDUCTION COILS AND SUB-STATION CIRCUITS.

THE earliest telephone line was simplicity itself. As illustrated in Fig. 1, it consisted of two magneto-telephones, each of which acted as transmitter and receiver alternately, united by a pair of wires, or even one wire could be dispensed with, and the "ground" employed as a return, as shown by the dotted line. But such a cir-

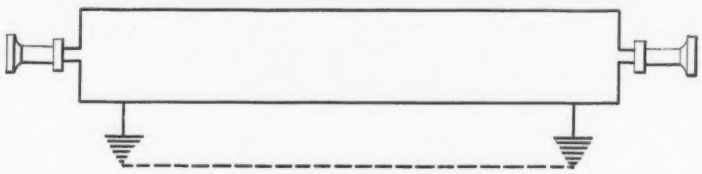


FIG. 1.—EARLIEST TELEPHONE CIRCUIT.

cuit could be employed only over short distances, because the impulses of the magneto telephone are too feeble to be intelligible over long lines. The invention of the battery telephone, which acted as an electric valve to allow power from a source independent of the transmitter to be available, rendered it practical to talk over much longer lines; but with this improvement simplicity had to be sacrificed. It was necessary to provide a separate receiver and transmitter at each station, and introduce a battery as a source of electricity, something as shown in Fig. 2. Consider such a circuit in the light of the transmitter operating as an electric valve. The effect on the receivers will be approximately proportional to the *changes* in the currents that traverse the circuit, and not at all to the actual volume of electricity. These pulsations are produced solely by such variations in the total opposition offered to the flow of electricity from the battery, as are due to the increase and decrease in the resistance of the microphonic contact in the transmitter set up by the changes in pressure on its diaphragm caused by the sound waves that impinge thereon. A circuit of this kind may be divided into four parts, each of which presents its own individual barrier to the passage of electricity: First, there is the opposition due to the receiver. The ohmic resistance of the receiver may vary from 50 to 100 ohms; but as its coils are wound upon an iron core, its reactance is large, and, at the high frequency of telephonic currents, its impedance is considerable. Second, there is the opposition offered by the line wire, which will vary with its length, material and size. Assuming the line to be essentially straight, and of average length, say, about a mile, its opposition will be chiefly due to ohmic resistance, because its inductance is inappreciable, only a few millihenrys and the entire impedance of this portion of the circuit will not exceed, say, 100 ohms. Third, there is the opposition of the battery that is entirely non-inductive, and, even in the case of high resistance cells, will not

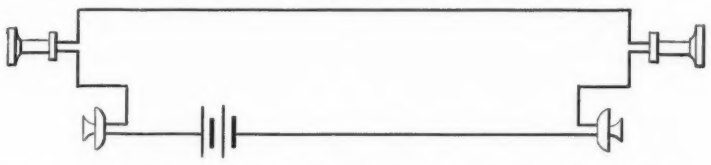


FIG. 2.—CIRCUIT WITH BATTERY TRANSMITTER WITHOUT INDUCTION COIL.

exceed a dozen ohms. Finally, there is the variable, though non-inductive, resistance of two transmitters, either of which may, from time to time, change from a fraction of an ohm to several hundred ohms, though it is rare to find transmitter resistance of more than 25 or 30 ohms.

So a telephone line connected as shown in Fig. 2 will offer an impedance of a thousand ohms or more, though its ohmic resistance would rarely rise above two hundred. Now, to make a favorable assumption, suppose the transmitter to be endowed with an ability to produce a maximum variation of 50 ohms; it would then be able to change the total impedance of the circuit about 5 per cent., and, therefore, its power of producing pulsations in the line current will be correspondingly small. To enable a transmitter to produce a greater effect, the circuit must be so planned that the change in the transmitter resistance will be a much greater proportion of the total circuit impedence. This Mr. Edison accomplished in 1878 by the aid of a *transformer,* or, in telephonic language, an induction coil. Mr. Edison's arrangement, and one which still survives unchanged in local battery installations, is shown in Fig. 3. Two receivers (*RR*) are united by a line, at each sub-station a transformer (*C*) is introduced. This transformer consists of an iron core upon which there are two windings, one of coarse wire, having relatively few turns, and of low resistance, while the other is of fine wire, much higher resistance and many more turns. The fine wire is placed in series with the line and receivers, while the coarse wire forms a local circuit, having a transmitter and battery in series with it. Fifteen years ago the theory and use of the transformer was but little known and practised, the spark coils of Ruhmkorff and others being about the only application of the principles of induction. While Prof. Gray had previously employed an induction coil in telegraphic work, Edison's application of it to the battery transmitter must be regarded as one of the great inventions of telephony.

The induction coil performs four entirely separate and distinct functions: First, it provides a local circuit for each transmitter, that by proper design can be made of so low an impedance that the variations in the resistance of the microphonic contact shall form a very large percentage of the total electrical opposition of the circuit. Second, it removes both transmitters from the line circuit, thus decreasing its resistance. Moreover, as the transmitter is of variable resistance, its direct presence in the talking circuit is exceedingly

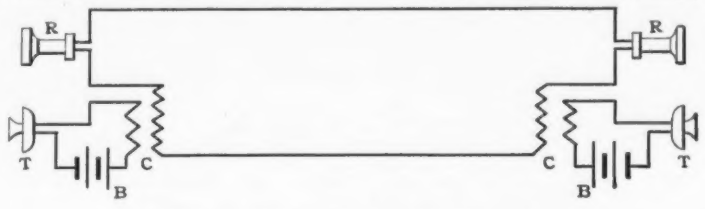


FIG. 3.—CIRCUIT WITH INDUCTION COIL.

objectionable. Third, the analogy of the transmitter to the electric valve leads to the belief that all the impulses it produces are positive quantities, or, so to speak, the transmitter injects jets of electricity into the line. Its action may be illustrated by Fig. 4, in which *AB* is the line of no current, *CD* the current line when the transmitter is at rest, and *EF* a representation of positive impulses superimposed upon the line *AB*. Even under the most favorable conditions, the impulses produced by the transmitter are small in comparison with electrical quantities that are met with under other circumstances. A few measurements upon transmitter currents have been made, the most recent of which are the experiments by Prof. Cross at the Massachusetts Institute of Technology. The various vowel sounds were pronounced in as uniform a tone as possible in front of various transmitters and the result on line current measured by a dynamometer. These tests are summarized in Table No. 1:

TABLE I.

LINE CURRENTS FROM VARIOUS TRANSMITTERS WITH DIFFERENT VOWEL SOUNDS.

Kind of Transmitter.	Vowel Sounds and Currents in Milliamperes.			
	a	o	u	i
Hunning	.737	.787	.503	.213
Fitch	.450	.548	.442	.264
Blake	.123	.144	.114	....
Edison	.088	.123	.144	.072
Magneto	.123	.260	.238	.103

Subsequently, other tests were made with a solid back, to test the effect upon the line current of varying pitch of the voice an octave. These results are shown in Table No. 2:

TABLE II.

RELATION OF LINE CURRENT TO PITCH OF SOUND.

Vibrations per second.	Vowel Sounds and Current in Milliamperes.				
	a	e	i	o	u
128	.300	.270	.250	.350	.200
236	.670	.620	.420	.680	.540

Fourth, the addition of the transformer changes radically the form of the impulses, because a pulsating current impressed upon the primary gives rise to a wave in the secondary which is an alternating one, and is more efficient in exciting the diaphragm of the receiver. This is illustrated in Fig. 5, in which *AB* is the line of no current, corresponding to *AB* of Fig. 4, while *CD* represents the current wave in the secondary, corresponding to *EF* in the primary. Fifth, it is well known that one of the most valuable properties of the trans-

former is its ability to vary the current and pressure relations of its primary and secondary circuits. This variation is nearly in proportion to the ratio of the number of turns in the primary to the number of turns in the secondary. Thus, if there are P turns in the

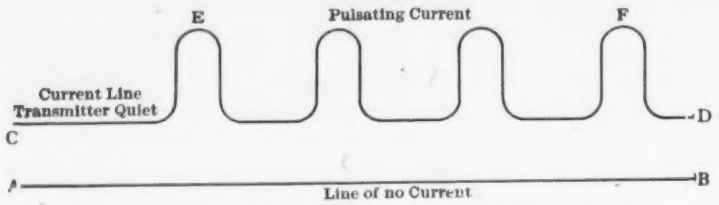


FIG. 4.—DIAGRAM OF CURRENT IN A TRANSMITTER CIRCUIT.

primary and P' turns in the secondary, the ratio is $\frac{P'}{P}$. If V volts be applied to the primary producing in the secondary a current of C am-

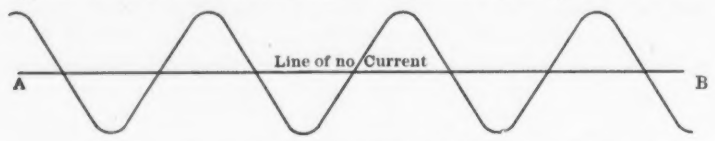


FIG. 5.—CURRENT IN SECONDARY OF INDUCTION COIL.

peres, the volts at the terminal of the secondary will be $\frac{V P'}{P}$ and the current will be $\frac{C P}{P'}$. Now, line losses in any transmission system are proportional to the square of the current which is employed, while the energy transmitted is proportional to the product of the pressure and the current. Consequently, by reducing the current and increasing the pressure, the same amount of energy may be transmitted, accompanied by much less loss. Owing to arcing at the michrophonic contacts it is impossible to operate a transmitter excepting at low voltages; but the induction coil affords the ability to transform the low pressure and relatively large current of the local circuit into high pressure and correspondingly small current in the secondary circuit.

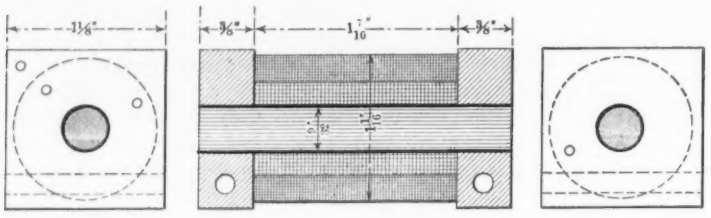


FIG. 6.—INDUCTION COIL FOR BLAKE TRANSMITTER, LOCAL BATTERY.

SPECIFICATIONS FOR FIG. 6.

Core: Bundle of No. 24 soft iron wire.
Diameter of core, 9/32 in.
Length of core, 2¼ in.
Winding space, 1 7/16 in.
Paper insulation around core, 1/32 in. thick.
End blocks ⅜ in. thick, 1⅛ in. square.
Winding: Inside winding.
Resistance, .6 ohms.
290 turns No. 22 single silk covered wire, wound from end to end of core.
Two layers of common paper insulation around it.
Outside winding.
Resistance, 250 ohms.
3000 turns No. 36 single silk covered wire wound from end to end of core.

Enough has been said to indicate the importance of the induction coil, and, therefore, the desirability of obtaining such a design as

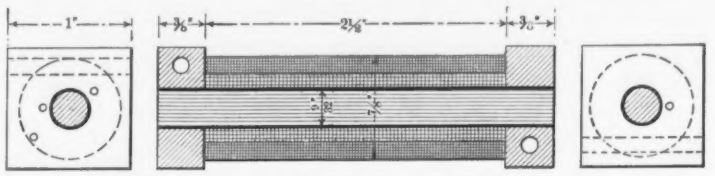


FIG. 7.—INDUCTION COIL FOR SOLID-BACK TRANSMITTER, LOCAL BATTERY.

SPECIFICATIONS FOR FIG. 7.

Core: Bundle of No. 24 soft iron wire.
Diameter of core, 9/32 in.
Length of core, 3¼ in.
Winding space, 2⅜ in.
Paper insulation around core 1/32 in. thick.
End blocks ⅜ in. thick, 1 in. square.
Winding: Inside winding.
Resistance, 1.76 ohms.
400 turns No. 26 single silk covered wire wound from end to end of core.
Two layers common paper insulation around it.
Outside winding.
Resistance, 21 ohms.
1600 turns No. 28 single cotton covered wire wound from end to end of core.

will secure a maximum of the advantages thus outlined. Unfortunately, records of experiments made to determine the best proportions for induction coils are few and difficult to secure. A valuable set of experiments upon a number of coils made by the Swiss Telephone Department is reported by Sir William H. Preece. The results of these experiments are summarized in Table No. 3:

The tests referred to in Table No. 3 were made by taking the induction coil of a Blake transmitter as a standard and comparing therewith, over various lengths of lines, the coils designated in the first column of the table. Unfortunately, the electrical properties of the standard coil were not recorded.

The Iowa Electrical Association Convention.

The fourth annual convention of the Iowa Electrical Association will be held at Des Moines on April 13 and 14, 1904, at the Savery House. The programme as announced so far is as follows: "Uniform Accounting," by Austin Burt; "Electric Motors," by George W. Carson; "Combustion of Iowa Fuel," by Prof. George W. Bissell; "Incandescent Lamp Tests," by Prof. Spinney; "Station Steam Piping," by Mr. Gartlain; "Nernst Lamp Experiences," by Mr. G. C. Gardner; "Series Street Lighting," by Mr. Harrison; "Multiple Street Lighting," by Mr. Lee; "Storage Batteries," by Mr. Reavy; "Demonstrated Talk on Station Accounting," by Mr. Robert Ferris; "Question Box," by W. J. Greene.

TABLE III.—INDUCTION COIL TESTS SWISS TELEPHONE DEPARTMENT.

	Primary Coil.			Secondary Coil.			Length of Line in Miles and Relative Results.									
							.31		38		49		53		67	
Designation of coil.	Number of turns.	Size of wire B. & S. gauge.	Resistance.	Number of turns.	Size of wire B. & S. gauge.	Resistance.	Volume.	Clearness.	Volume.	Clearness.	Volume.	Clearness.	Volume.	Clearness.	Volume.	Clearness.
1	61	24	.25	1956	35	100	.3	.9	.9	1.0	.3	.7	.7	.8	.2	.9
2	62	24	.25	3191	35	180	.7	.9	1.0	1.1	.9	1.0	1.0	1.3	.7	1.0
3	62	24	.25	4080	35	250	.9	.9	1.0	1.3	.9	1.0	.9	1.3	.6	1.0
4	116	24	.50	3952	35	250	1.5	1.3	1.7	1.5	1.3	1.5	1.3	1.5	1.2	1.5
5	230	24	1.00	3865	35	250	1.3	1.0	1.3	1.2	1.1	1.3	1.3	1.5	1.0	1.3
6	232	24	1.20	4420	35	300	1.5	.9	1.6	.9	1.7	1.3	1.7	1.6	1.5	1.5
7	295	24	1.50	4278	35	300	1.3	.9	1.5	.9	1.1	1.1	1.5	1.4	1.6	1.3
8	368	24	2.00	4735	35	350	1.3	1.0	1.5	.9	1.1	1.0	1.5	1.4	1.6	1.2
9	368	21	1.17	4735	29	130.2	1.7	1.0	1.6	.9	1.7	1.4	1.6	1.6	1.7	1.3
10	1350	24	10.00	3950	35	400	[illegible]	.3	.3	.5	.3	.3	.3	.4	.3	.1

Methods of Signaling and Operating in Telephone Exchanges—VI.

BY KEMPSTER B. MILLER AND CHARLES S. WINSTON.

(Concluded.)

WESTERN ELECTRIC SYSTEM C. MODERN BELL SYSTEM.

IN the previous article descriptions were given and illustrated of the two Western Electric toll systems, designating them as A and B. In one two wires are used in toll trunk circuits, in toll systems. In the other three wires are used in the toll trunk circuits. As neither of these systems, A or B, was considered entirely satisfactory by the American Bell Telephone Company, particularly on the ground of not being rapid enough in operation, the engineers of this company set to work to design a system capable of more rapid service, and which would have the advantages of both systems, A and B, with as few as possible of their disadvantages. As a result, about two years ago there was put in operation a new system, which has apparently proved more satisfactory than any of the systems yet tried by the Bell Companies, although it has one disadvantage in the extreme complexity of some of its circuits.

In this system, which we will call "System C," the cord circuits at the toll board are of such a nature that they can be used without change for making connections between two toll stations or between one toll and one local station. The system has advantages in that it affords greater ease of operation and, further, in that the cord circuit is not encumbered by a repeating coil and a repeating coil key. Toll trunk circuits are furnished, appearing as jacks in the toll sections and as plugs and lamps at the toll switching positions on the local switchboard. In addition to this recording toll trunk circuits are provided, which end at the recording operator's positions in lamps and jacks, and appear as multiple jacks only in each section of the local multiple switchboard. Locking relays and lamps controlled by them are used in both the toll line and cord circuits in place of line and clearing-out drops. At each subscriber's operator's position at the multiple switchboard, there is furnished one or more pairs of "tone test" cords adapted to throw a special tone busy test on to any line. With one of these cords which is intended to be connected with the jacks of the local common battery subscribers, is associated a white lamp, and with the other, which is used to connect with the jacks of the recording toll trunks, a red lamp.

The method of operation of this system in establishing a local to toll connection is as follows, reference being made to Fig. 12. A

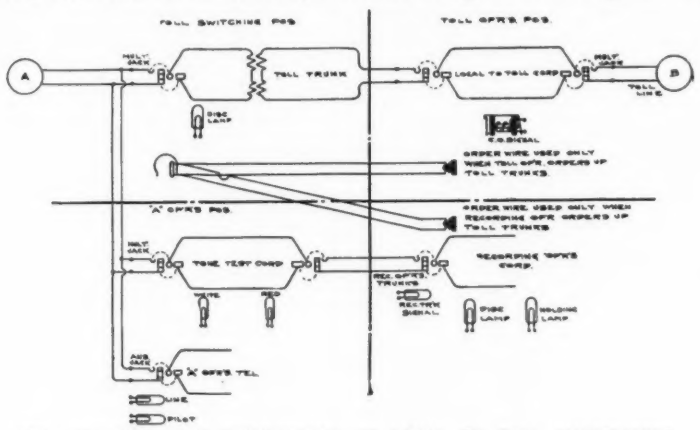


FIG. 12.—SHOWING CONNECTION OF LOCAL TO TOLL SUBSCRIBERS. WESTERN ELECTRIC "C."

local subscriber desiring to talk over a long distance line will signal his local operator and ask for "toll" or "long distance." The operator will then insert the answering plug of a pair of tone test cords into the multiple jack of the calling line. She will then withdraw the answering plug of the regular pair of cords which she inserted into the answering jack of the calling subscriber's line in response to his call. The white lamp in the tone test cord circuit will remain unlighted as the subscriber with whose line the jack is connected has his receiver off its hook. With the second plug of the tone test circuit the operator will then test the multiple jacks of the recording toll trunk lines, and upon finding one that is not in use, will insert the plug into it. The second (red lamp) in the tone test circuit will also remain unlighted, but a lamp at the recording operator's position associated with the recording trunk circuit will light, and the recording operator having plugged into this jack will find out from the calling subscriber what toll connection is desired and also the number of his own line. From this information the recording operator will make out a ticket.

Generally, the recording operator is furnished with cord circuits each having a single plug and two lamps. One of these lamps (the holding lamp) is placed under the control of the calling subscriber when the plug with which it is associated is inserted in the proper toll trunk jack, and the second is a disconnect lamp. The operation of the latter lamp will be described below.

It will be seen that the method by which the recording toll operator receives the information from a calling subscriber is the same as that used in the Kellogg system, with the exception that the connection between the calling subscriber's line and the recording toll trunk is made by means of special pair of cords instead of by regular cords, as in the Kellogg system, and also through the multiple jack of the calling subscriber's line, rather than through his answering jack.

After making out the ticket the recording operator has two courses of action open to her, her decision depending on whether or not she has reason to believe the connection called for may be at once obtained. If she thinks it will be some time before it will be possible to establish the connection desired, she will tell the calling subscriber to hang up his receiver and wait until called. The hanging up of the subscriber's receiver will light the white lamp of the tone test cord used in making the connection, but the subscriber's operator will pay no attention to this, her signal for taking down the connection being the lighting of the red lamp. Having told the calling subscriber to hang up his receiver, the recording operator will then pass the ticket to the toll line operator and remove her plug from the recording toll trunk jack, which will light the red lamp in the tone test cord circuit at the multiple switchboard. The lighting of this red lamp gives the signal to the subscriber's operator to take down the connection, and she therefore pulls down both of the tone test plugs leaving the calling subscriber's line free for other use.

The object of the white lamp in the tone test cords is not to serve as a disconnect lamp, but to provide at all times a signal by means of which the local subscriber can attract the attention of the operator even while his line is being held for the toll connection.

If, after making out the ticket, the recording operator has reason to believe that the connection may be at once obtained, she will press an order-wire key enabling her to speak directly to the toll switching operator at the multiple switchboard and give her the number of the line with which the connection is to be made. In response to this the toll switching operator will give the recording operator the number of the trunk line which is to be used, and the recording operator will place this number on the ticket. The toll switching operator will then test the multiple jack of this line, and will receive the special "busy" test, due to the presence of the tone test plug in the multiple jack at the section at which the call was initiated. She is instructed, however, to disregard this special busy test, but to all other operators in the exchange this test has the same significance as the regular "busy" test.

After the toll switching operator has inserted the designated trunk plug into the multiple jack of the calling line, the recording operator will withdraw her plug from the recording trunk jack and insert it into a multiple jack of the toll trunk line designated. These trunks are multipled on all toll and recording sections. After speaking to the subscriber, thus satisfying herself that the connection is, so far, complete, and that the subscriber has given his proper number, she will tell him to "wait a minute." She will then pass the ticket to the toll operator who has charge of the toll line with which the connection is to be established. The act of withdrawing the recording plug from the recording trunk jack will light the red lamp in the tone test circuit at the multiple board, and the operator will remove the tone test plugs from both the subscriber's and recording trunk multiple jacks. It will then be impossible for the subscriber to signal his operator, but the act of moving his receiver will flash the holding lamp at the recording operator's position. As, previous to removing the tone test cords at the multiple switchboard, the white lamp in this circuit was under the control of the subscriber, it will be seen that there is no time that the subscriber cannot signal the exchange.

It will be seen that if the recording operator thinks it will require some time to obtain the toll line desired, she causes the local subscriber's line to be freed, and leaves the toll operator to order up the

toll trunk. If, however, she believes that the connection can be immediately made up, she causes the local subscriber's line to be held as busy, and will order up the toll trunk herself. In the former case the ticket received by the toll operator will have no trunk line designated upon it, while in the latter case, it will.

When, therefore, the toll line operator receives the ticket from the recording operator, she will, if no trunk is designated, first insert an answering plug into the multiple jack of the desired toll line and ring. After the call has been answered, the toll operator will give to the switching operator over an order wire, the number of the subscriber's line with which connection is to be made, and receive in return the number of the trunk line to be used, whereupon she will insert the calling plug, which is associated with the answering plug in use, into the multiple jack of the designated trunk line and call the desired subscriber by ringing. If she finds that the trunk line is designated on the ticket and that the recording operator has already ordered up the connection at the toll switching section, she will first insert an answering plug into the jack of the trunk designated on the toll ticket. This act will light the disconnect lamp in the cord circuit of the recording operator, and this operator will remove the plug from the toll trunk jack. The supervision of the connection will then be entirely in charge of the toll line operator, as the multiple board subscriber will light the supervisory lamp in the toll cord circuit by operating his receiver hook. Having inserted the answering plug into the jack of the toll trunk line designated, she will test the multiple jack of the toll line. If, by testing, the toll line operator finds that the desired toll line is not in use, she will insert the calling plug of the pair used, into the multiple jack of this line and call up the toll subscriber. She will listen in at short intervals so as to know when the subscriber answers and the conversation has begun.

At the end of conversation the act on the part of the toll subscriber or of a distant operator of sending current over the line, or on the part of the common battery subscriber of hanging up his receiver, will operate the relay in the toll cord circuit and light the supervisory lamp. The operator will then throw the listening key, thus extinguishing the lamp, and, after having assured herself that the signal is for disconnection, take down the plugs. When she withdraws the plug from the toll trunk circuit, she will automatically light the disconnect lamp associated with this trunk line at the toll-switching position of the multiple switchboard, and the toll-switching operator will remove the toll trunk plug from the multiple jack of the subscriber's line.

The toll trunk line leading from the toll board to the toll-switching operator's position of a local multiple board consists of two wires only, and in order to bring about the advantage of having the cord circuits on the toll positions universally adaptable to any kind of a connection, the repeating coils are placed in the toll trunk circuits rather than in the toll cord circuits. In spite of the presence of this repeating coil, however, the toll operator, in this system, rings the local subscriber instead of having the trunk operator perform this operation, as in system A. This arrangement is made possible by a series of relays so wired that when the toll operator rings on the trunk line, the generator current which she thus causes to flow over the trunk line and through one side of the repeating coil at the toll-switching end of this line, will pull up a relay which will send generator current out on the subscriber's line without passing through the other side of this repeating coil.

When a person at a long distance station desires to converse with a common battery subscriber the current from his generator will energize a relay which will light a lamp at the toll board. From this it will be seen that the latest Bell practice discards the old scheme of having drops for line signals on the toll boards, as well as for supervisory, lamps being used in their places.

When the toll operator answers a call the act of inserting the plug into the answering jack will extinguish the line lamp. Having found that the call is for a common battery subscriber, the toll operator will speak over an order wire to the toll-switching operator at the multiple board telling her the number of the common battery line with which the connection is to be made and the toll-switching operator will designate the trunk, and, after testing and finding that the line is clear, insert the plug of this trunk into the multiple jack of the local line. The toll operator will insert the calling plug associated with the answering jack in use into the multiple jack of the toll trunk line and ring the local subscriber. At the end of the conversation the disconnect signals will be received in the same manner as described, the signal coming to the toll operator, who, when she takes down the connection, conveys the disconnect signal to the toll-switching operator.

If in a call from a toll for a local subscriber the call-switching operator in testing the multiple of the designated local line, as described, finds it busy, she will insert this plug into a busy back jack, and thus notify the toll operator by tone that the connection cannot be put up immediately. The toll operator will then tell the person at the toll station, who is making the call, to hang up his receiver and that as soon as possible he will be called.

Meanwhile the toll operator will frequently remind the toll-switching operator to test the multiple jack of the local subscriber's line in order to ascertain when it is no longer busy, so that the connection may be made.

It would seem that this latter feature might be improved upon, and that a signal should be provided for notifying the toll operator automatically as soon as the local subscriber's line was no longer busy, after which she could immediately complete the connection.

For the handling of toll-to-toll calls, a separate position or positions is provided on the toll board called "through" positions. If the toll operator receives a call from a toll line for another toll line she will make out a ticket for it in the same manner as if the call were for a local line and, on completing the ticket, will establish the connection herself if the line called for is not busy. If, however, it is in use, she will pass the ticket to the through operator, who has in front of her a multiple jack of each line, and, in some exchanges, a lamp which remains lighted as long as that line is busy. This operator, as soon as she finds that both lines are free, either by noting that the lamps of both lines are extinguished, if her position is provided with lamps, or by testing, in case she has none, will establish the connection. At the end of the conversation on such a connection the supervisory lamp will light in the ordinary manner when either of the toll subscribers turns his generator crank.

Recent Electrochemical Developments.

ELECTROMETALLURGY OF STEEL.

Among the successful European metallurgists who have introduced electric furnace methods into the metallurgy of iron and steel is Mr. C. A. Keller, of Paris, whose steel process is in use at Kerrousse, in the Houille Blanche ("white coal") district. It has recently been stated that Messrs. Keller, Leleux & Co. are contemplating a steel works in this country. For this reason a patent granted on March 15 to Mr. C. A. Keller is of special interest. He uses a double furnace, the upper furnace operating as a stack furnace for the reduction of the metal, while the lower furnace serves for refining or alloying purposes. The upper furnace is characterized by the continuity of its operation and the possibility of the utilization of great power and great capacity. It contains four vertical electrodes disposed upon the four corners of a square, their lower extremities being placed in the refractory vessel which constitutes the fusion chamber. The column of ore charged into the furnace may serve at the same time for a chimney with return flue, and has an exterior diameter such that it may be located between the upper extremities of the electrodes which emerge above the roof of the fusion chamber. Two electrodes are connected to the positive pole and the other two electrodes to the negative pole of the supply circuit. With this arrangement the operation of the furnace is rendered continuous, since one of the four electrodes may be easily replaced without stopping the operation. Readings of the four ammeters, in the branch circuit of each electrode, permit adjusting the intensity of the current in the four heating zones. Each of the electrodes is provided with an operating mechanism which permits its vertical regulation.

IRON-NICKEL STORAGE BATTERY.

Two patents granted to Mr. Thomas A. Edison refer to details of mechanical construction of his iron-nickel storage battery. One patent relates to the use of glass tubes or rods for mechanically supporting and separating the electrodes, and at the same time for electrically insulating the electrodes from the bottom and sides of the containing vessel. The other patent relates to a light, cheap tray, arranged to carry and securely hold together a series of storage batteries, so that, by assembling several such trays with their cells, a complete outfit is produced which is particularly adapted for use on automobiles.

Vertical Motor-Generator Set.

A short time ago the Lend-Gastein (Austria) branch of the Neuhausen Aluminum Industrie Gesellschaft was equipped completely with electrical apparatus furnished by the Oerlikon Company, of Oerlikon, near Zurich, Switzerland. The most interesting feature of this installation is the use of vertical motor-generator sets, of which there are six in all. This type was chosen owing to the satisfactory service given by the vertical generators used in connection with the turbines in this plant. It was found that the vertical arrangement permitted the machinery to be handled with greater ease. The carbon and copper dust falls directly downward and, therefore, cannot get into the armature windings.

The motors of each set are of the synchronous type, each built to give 1,000 hp at 10,000 volts, 45 cycles, 340 r.p.m. The 160-volt, direct-current generators are each of 560-kw capacity.

The generator field is made of cast iron. The motor armature is placed directly above the field of the generator, and is enclosed by a single-piece cast-iron frame. The rotors of both machines are rapidly attached to each other and revolve around the stationary shaft, which is lubricated by means of the oil cup shown at the top of the shaft in Fig. 3. The total weight of the rotors is 27,500 pounds. This weight is taken up by a spur foundation located beneath the commutator of the generator. The stationary cast-steel spur plate is frustum-shaped and rests in a cast-iron pan. The shell of the lower foundation, which is built into the commutator, has a flange at its bottom resting on the spur plate. Both the spur plate and flange have a circular groove for taking up the oil after lubrication. This oil is pumped through the machinery under a pressure of ten atmospheres. The entire supporting foundation, including the pumping machinery, is built in a cast-iron housing completely filled with oil so that lubrication is insured even if the pump fails. The oil is kept cool by a spiral copper pipe which conveys cold water through it.

The generators have twelve poles each and are shunt wound. The armature has an outside diameter of 4.9 ft. and a core diameter of 1.3 ft. The core is cooled by two ventilating slits. The armature contains 204 open slots for the windings, each slot containing four insulated copper wires. The connection between the armature winding and the commutator is made according to a new system devised by the Oerlikon Company, consisting in the use of copper forks, each of which combines two commutator laminations, separated from each other by twice the polar division, with the corresponding armature winding. The commutator consists of 408 segments of hard-drawn copper, 24 in. long, and with an outside diameter of 36 in. All insulating rings in the interior of the commutator are of mica. The twelve poles which carry the shunt windings are built of soft sheet iron and are screwed to the field frame. Corresponding to the twelve poles the brush holder has twelve brushes, each of which is furnished with 11 carbon tips. These brushes are arranged so that all of them can be raised simultaneously when necessary to clean or true the commutator.

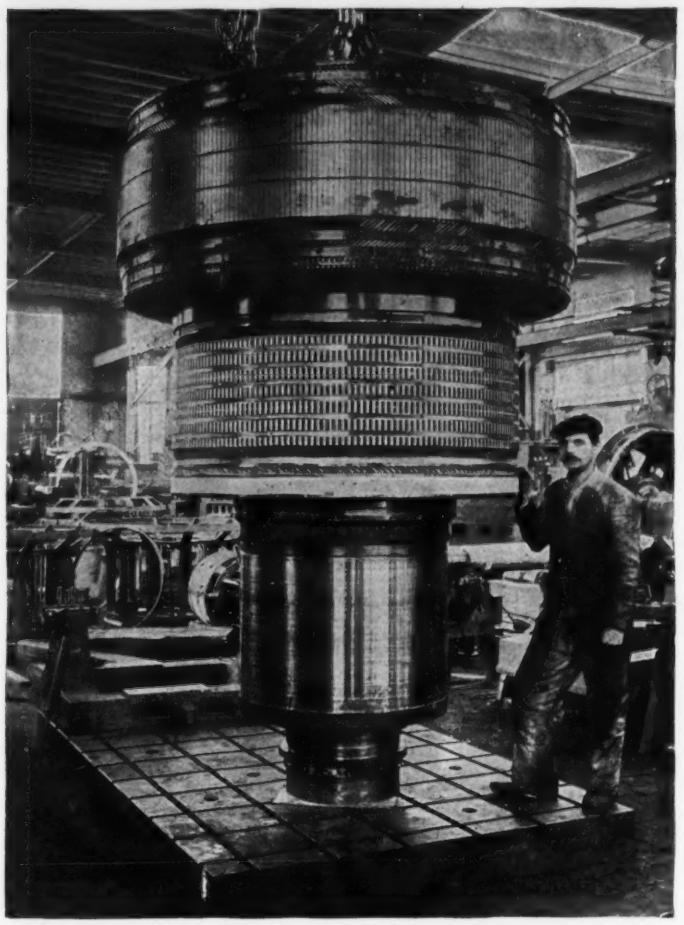


FIG. 2.—VIEW OF THE ROTORS.

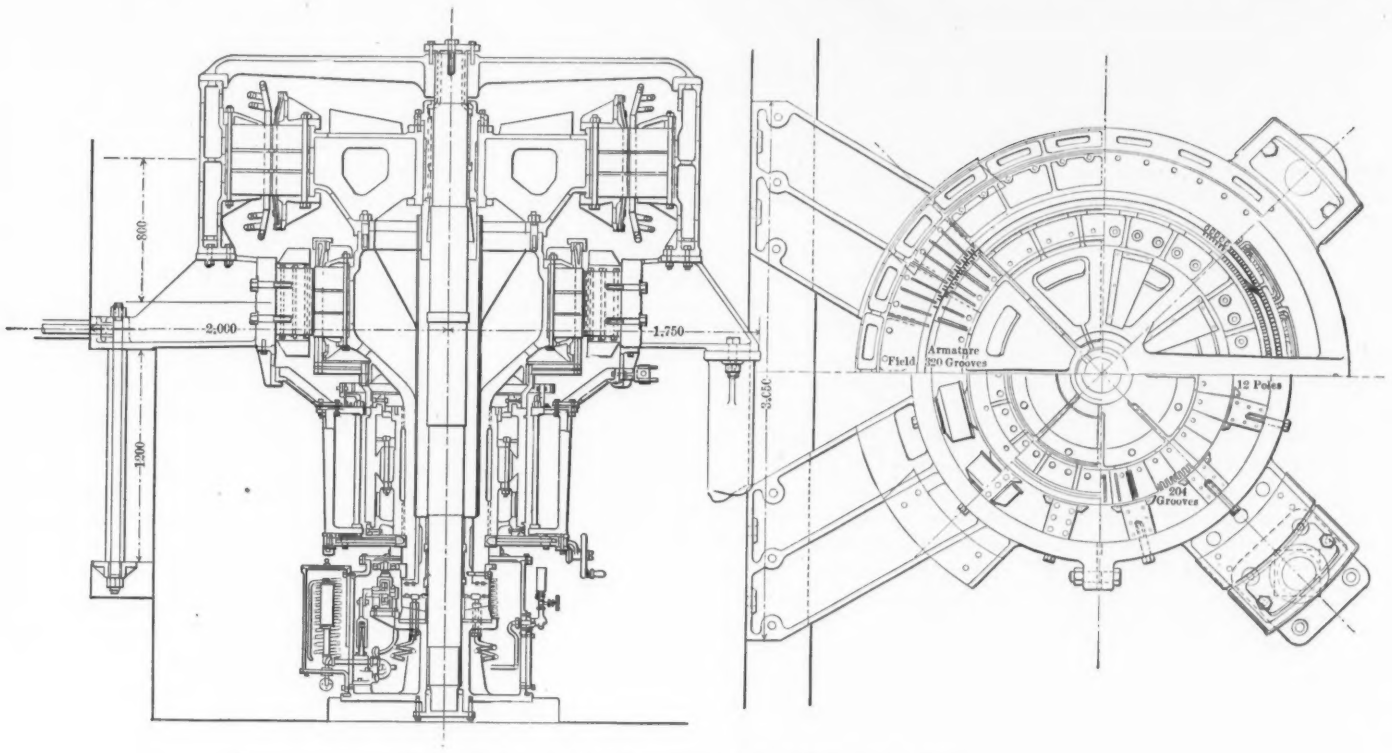


FIG. 1.—DETAILS OF VERTICAL MOTOR-GENERATOR SET.

The motor has sixteen poles. The high-tension winding is laid in 192 slots. Each slot contains eighteen series wires insulated from each other by mica sheets .1 in. thick. The winding is hand-wound, and the wires have a diameter of 4 mm. The rotor of the motor has

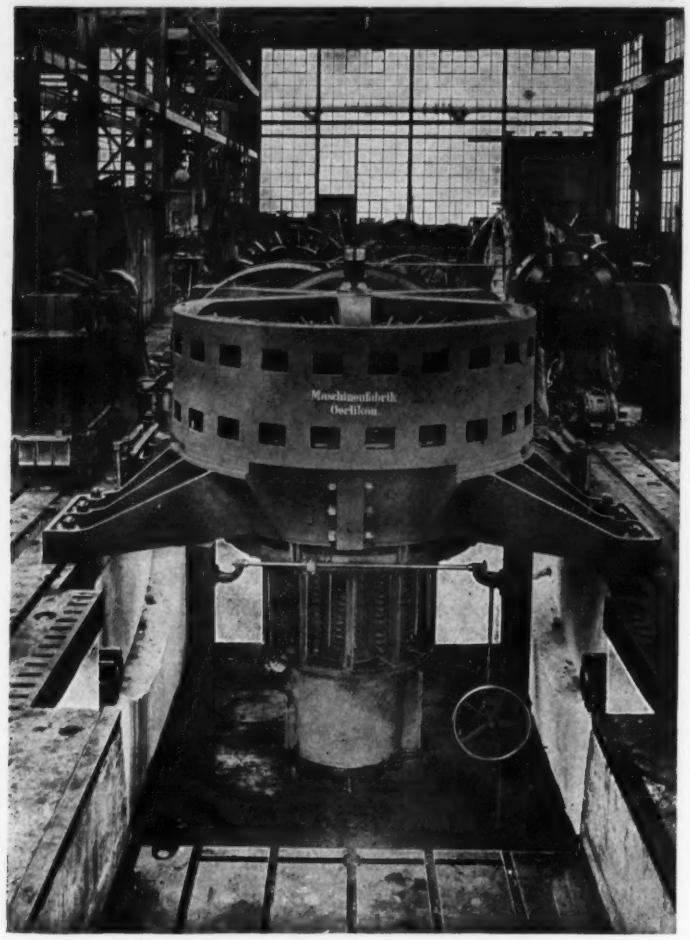


FIG. 3.—GENERAL VIEW OF MACHINE.

a short-circuited winding laid in 320 semi-open slots. Each slot contains two spool halves. Each spool forms a closed winding, and consists of three parallel copper strips 8 x 2.5 mm. cross-section. It is noteworthy that the motors have an air-gap of 2.5 mm., though $\cos \phi$ attains a maximum of 0.94.

Drying Out High-Tension Transformers.

To the March issue of the *Electrical Club Journal* Mr. J. S. Peck contributes an article on "Methods of Drying out High-Tension Transformers." Three methods are described, namely, by the use of internal heat, external heat and internal and external heat combined. In applying the first-mentioned method, the transformer should be placed, if possible, in its case, though this is not essential, as it may be left in its shipping case or even placed on the floor of a dry room. If dried out in a case the cover should be removed to give free circulation of air. The low-tension winding should be short-circuited, and a sufficient voltage impressed on the high-tension winding to circulate the desired current through the coils. For large transformers (250 to 500 kw), approximately one-fifth normal full-load current will be sufficient to raise and maintain the coils at the desired temperature, viz.: approximately 90° C. (194° F.). For small transformers a somewhat larger current will be required. For circulating this current through the windings, from 1 per cent. to 2 per cent. of the normal high-tension voltage at normal frequency will be required; thus, for a 10,000-volt transformer from 100 to 200 volts is necessary. For controlling the current a rheostat may be placed in series with the high-tension winding.

In applying the external heat method, the transformer should be placed in a wooden box, the packing case answering the purpose very well. An opening should be made near the bottom and another at the top of the box to permit a circulation of air and also to serve as a means of controlling the temperature of the air inside the box. The heat may be applied by circulating current through resistances, the iron grid form is frequently most suitable, placed at the bottom of the box. It should be applied at such a rate that the transformer coils will be maintained at approximately 90° C. (194° F.). Care should be taken to protect the transformer from direct radiation from the heaters. Care must also be taken to see that there is no inflammable material near the heaters which may catch fire. This method of drying out has an advantage over the method outlined in (*a*) in that direct current may be used for heating.

Instead of placing the heater inside the box containing the transformer, it may be placed outside and the heat carried into the box through a suitable pipe. Where this plan is used the heat may be generated by the direct combustion of gas, coal or wood, but none of the products of combustion should be allowed to enter the box containing the transformer. Heating by direct combustion is not advised except in case where electric current is not available.

In the internal and external heat methods the transformer should be placed in a wooden box as in the above method, and external heat applied, while at the same time a small amount of current is circulated through the transformer windings. The method of circulating the current should be the same as given in the first method discussed, and the method of applying the external heat the same as given in the second method. The current should, of course, be considerably less than when no external heat is used, the value being determined, to a certain extent, by the amount of external heat applied. This method is used occasionally where direct current only is available, a certain amount of current being passed through the high-tension winding only, as the low-tension winding is ordinarily wound for so heavy a current that it cannot be obtained economically from a direct-current circuit.

The length of time the drying-out should be continued will depend largely upon the condition in which the transformer is received, and unless in very bad shape, a week's run should be sufficient to put the transformer in good condition. In certain cases, however, it has been found necessary to continue the run for a somewhat longer time.

It will be found that when the current is first applied and the transformer heats up, the insulation resistance will drop very rapidly, until the desired temperature is reached; then, as this temperature is maintained constant, the resistance will gradually increase. It will also be found that variations from a constant temperature will cause wide changes in resistance. Resistance readings should be made every few hours and the drying continued until the resistance no longer increases, or increases at a very slow rate.

Certain precautions are to be observed in the work. In order to dry out the transformer, it is necessary to maintain it at a temperature which approaches the point where fibrous materials deteriorate. Great care must, therefore, be observed during the whole period of drying out to see that the temperature does not reach a value much in excess of 90° C.

For measuring the temperature of the transformer coils, several thermometers should be used. These should be placed well in between the coils, near the top of the transformer, and screened from air currents, so that they will indicate the maximum temperature of the windings. As the temperature will rise quite rapidly at first, it is necessary to watch the thermometers carefully to see that the maximum allowable temperature is not exceeded.

As the transformer is soaked with oil, on account of the test which it receives in the works, the material is in an inflammable condition, and while hot it may be ignited very easily by a very small arc, or from a blaze of any kind. Before beginning the drying out, it is well to have some chemical extinguisher, or at least a supply of sand, at hand, which may be used in case of necessity. In general, it is not safe to attempt the drying out of transformers unless constant attention can be given to them.

Wireless Telegraphy in the Navy.

The United States Navy Department at Washington has recently made arrangements for the trial of several wireless telegraph systems between the Brooklyn Navy Yard and the station at Navesink Highlands, N. J. The system which produces the best result later will be tested between shore stations and ships and between ship and ship. The Navy Department continues to receive encouraging reports of wireless telegraphic achievements at sea.

New Telephone Patents.

RECEIVER HOLDER.

One has only to see a receiver dangling upon the end of its cord, representing the condition of holding the line while leaving the telephone, to wonder why some auxiliary support for the receiver is not provided. H. L. Goodwin, of Kansas City, has thought that such an auxiliary should be provided and he has put his thoughts into definite form in a receiver holder for which he has obtained a patent. This holder is bent up out of wire having a U-shaped form at one end into which the receiver may be slipped. The other end is given various shapes, according to the type of telephone instrument upon which it is to clamp. Clamping for all types results, however, from the natural spring of the wire. The only objection that can be advanced against such a support is that a receiver left upon it in error, resulting in the "hold-up" of the line, is much more likely to attract attention when swinging about at the end of a cord than when placed upon a support.

ANTISEPTIC MOUTHPIECE.

A new development in the antiseptic mouthpiece line is a joint invention of Messrs. W. M. English and A. H. Ten Broeck, of San Francisco, recently patented. This consists of a metal bell piece from one side of which an antiseptic-containing receptacle projects. The wall of the bell piece contains many fine perforations leading into the receptacle. Access to the receptacle for the insertion of antiseptic may be made in any one of various evident ways, for example, by making the bottom removable.

REPEATING APPARATUS.

S. Kitsee, of Philadelphia, has produced a most odd-looking repeater. It consists essentially of a galvanometer, the motions of whose needle is mechanically transferred to a pair of microphonic contacts. The galvanometer coil is, of course, included in the incoming circuit, and we are told that its resistance must be adjusted to suit the particular line in use. The needle of the galvanometer is compound, consisting of three independent needles upon the same spindle, their magnetic axes varying in direction by approximately 15°. The spindle is mounted in jeweled bearings. It carries not only the needles, but a long, horizontal arm, each end of which is bent downward. These ends carry conducting points which dip into small vessels containing dilute sulphuric acid. The variation of resistance of the primary of the repeating circuit results from the variation of the distance in the acid between the conducting point of the moving arm and a contact point in the bottom of the vessel. It would certainly seem impossible to proportion such an apparatus that the moving system might come anywhere near synchronizing with complex rapidly changing voice currents.

ANTISEPTIC MOUTHPIECES.

Things seem to be running in pairs in this patent issue and it is therefore not surprising to find two patents for antiseptic mouthpieces. One of these describes an apparatus commonplace enough, being merely a special form of perforated metallic mouthpiece lining with a space for antiseptic cotton or similar material between it and the mouthpiece proper. This is the combined invention of W. M. English and A. H. Ten Broeck, of San Francisco.

The second is entirely different, being built on the barbed-wire fence principle in that the ordinary mouthpiece is provided with a crown of round-headed pins so distributed that one cannot get his lips in contact with the transmitter. Its utility is certainly questionable from at least two points of view. In the first place, good transmission demands that the lips approach the mouthpiece closely, and secondly the metal crown should apparently be almost as good a receptacle of infection as such part of the hard rubber mouthpiece as one is liable to bring his lips in contact with. Mr. J. Blum, of Baltimore, has patented this latter device.

Plan to Merge Long-Distance Telephone Lines in Central States.

An important meeting was held at Indianapolis, Ind., on March 19 and attended by a number of the most prominent telephone men in the Central States. The purpose of the meeting was to formulate plans and discuss means of effecting a consolidation of all independent long-distance telephone companies operating in Western Pennsylvania, Ohio, Indiana, Illinois, Kentucky and Missouri, thus forming a chain of lines from Philadelphia, Cleveland, Indianapolis to Louisville and St. Louis. The United States Long-Distance Telephone Company, over whose lines the traffic of numerous independent telephone companies is now carried on, is said to be backing the enterprise, although the idea was originally conceived by S. P. Sheerin, of Indianapolis. In addition to the above named company the following are interested in the merger: The Pittsburg and Allegheny Telephone Company, the Cuyahoga Telephone Company, of Cleveland; the Citizens' Telephone Company, of Columbus, Ohio; the New Long-Distance Telephone Company of Indiana; the newly organized Indianapolis Telephone Company; the United Telephone Company of Bluffton, Ind. (covering the oil belt), and the Kinloch Telephone Company, of St. Louis. It is understood that an arrangement was agreed upon between the various companies represented whereby they will use each other's line for long-distance service in other States, and that where necessary short connecting lines will be built, so that coöperative service may be put into effect. The following prominent telephone men attended the meeting: J. C. Splain, of Pittsburg; Max Reber, J. B. Hoge and F. S. Dickson, of Cleveland; James E. Brailey, Jr., of Toledo; C. M. Foster, C. H. Ledlie, Breckinridge Jones, W. D. Orthwein, W. F. Nolker, Philip Stock, J. I. Drummond, Philip Scanlon, H. L. Reber, W. H. Bassett, E. B. Denison, W. R. McCanne and W. D. Pitman, of St. Louis; J. D. Powers, J. A. Armstrong, M. R. Telu and M. Brailey, of Louisville; Hugh Dougherty, of Bluffton, Ind.; C. S. Ramsey, of Crawfordsville, Ind.; S. P. Sheerin, H. B. Sales and H. B. Gates, of Indianapolis. After the meeting the officials of the New Long-Distance Telephone Company, of Indianapolis, gave an elaborate dinner to the visitors, at the Columbia Club.

Electricity Versus Steam.

A discussion as to the relative merits of steam and electricity took place recently at Public School No. 5, New York City, when it was voted that steam was now in second place. The case for electricity was brilliantly and cogently presented by Master Gainer, whose clinching arguments we quote from the daily papers, as follows:

"Electricity is better than steam, for gas hurts the eyes, and then besides, the coal trust is against steam. Steamships can be propelled by electric motors, without smoke, so can trains, as was showed by the race the other day in the papers, when an electric car beat the Empire State Express. If there was not sich a thing as steam there wouldn't a been that awful cave-in down town, when 25 live men were killed. There's lots of other sich things I could quote if they was time. Electricity cures people that are nervous and sick people, too, and there is electric fans in all theatres in summer. What does steam do but boil?"

CURRENT NEWS AND NOTES.

HIGH-TENSION MEETING IN CHICAGO.—The Chicago branch of the American Institute of Electrical Engineers will hold its meeting for the discussion of high-tension transmission on March 29 at 1741 Monadnock Block at 8 P.M., as usual.

WIRELESS TELEGRAPHY IN THE WAR.—One of the Port Arthur dispatches says: "The wireless telegraph station opposite the light house has failed to work, its instruments having been disturbed by currents sent out by the Japanese ships equipped with the wireless system."

QUICK CABLING.—A remarkable piece of quick cabling was done a few days ago between Melbourne, Australia, and London, England, a distance of some 17,000 miles. The result of a cricket match was transmitted by the British Pacific Cable, Canadian Pacific Telegraphs and the Commercial Atlantic Cable in two and one-half minutes. This is without doubt a record time. The message was relayed nine times.

MAGNETIC CLUB DINNER.—A complimentary dinner will be given by the Magnetic Club, of New York, to the officials of the New York Telephone Company and the New York & New Jersey Telephone Company. The dinner will be held about April 21 and a large attendance of telephone men is expected. The idea of this dinner is to afford an opportunity for telephone and telegraph men to meet and become better acquainted with one another.

IMPROVEMENTS IN DELIVERY OF TELEGRAMS.—The Postal Telegraph-Cable Company has adopted a new form of message blank and delivery envelope. The envelope is of the kind having an opening, technically called a "window," cut out of the front surface, a transparent oiled paper filling the space. The message blank is so folded that the address thereon will come in front of the "window" when the message is enclosed in the envelope. This innovation obviates the liability of error in rewriting the address on the envelope in the old way, and saves much time in handling. The Postal Company has always been quick to adopt new ideas tending to facilitate the handling of its business.

GERMAN TROLLEYS.—Mr. F. H. Mason, United States Consul-General at Berlin, writes: "Most, though not all, of the city lines are the property of one incorporated company, the Grosse Berliner Strassenbahn-Gesellschaft, which carried last year the imposing contingent of 316,000,000 passengers, an increase of 18,000,000 over the traffic of the previous year. For this service it received as fares 28,903,833 marks ($6,879,722), an average—including commutation and all other tickets—of 2.17 cents per fare. Within the city limits of Berlin the uniform fare for any distance is 10 pfennigs (2.5 cents), but there are no transfer tickets and the same fare must be paid on each line traversed by the passenger. Tickets from the central portions of the city to the outlying suburbs cost 2.5, 4 and 5 cents, according to distance, but all these are subject to slight reductions for commutation tickets. The importance of the Grosse Berliner as a factor in the transportation system of the city may be inferred from the fact that out of a total city and suburban population of 2,500,000 souls its lines carry an average of 865,000 passengers per day. The electric elevated and underground railway carried 29,473,355 passengers, for which the company received as fares 3,557,785 marks (846,752), or an average of 3 cents for each person. The heaviest traffic of the year was during the month of December, when 2,870,653 persons were carried; next came March, with 2,700,000; and last, July, with 2,093,000 passengers."

LETTERS TO THE EDITORS.

What Constitutes Invention.

To the Editors of Electrical World and Engineer:

SIRS:—I am interested in your editorial in the issue of March 19 on invention vs. engineering development. No one regrets more than patent lawyers the issue of unnecessary and trivial letters patent for invention; nevertheless I think your editorial is somewhat severe on the Patent Office, and on those who apply for what they regard as inventions.

The federal judges have always declined to define in advance what is invention, saying that each case must stand upon its own circumstances. You will doubtless pardon my saying that *ex cathedra* definition is no more to be looked for from an editor of a technical journal than from the courts; and I venture to say that it will be no more successful as a test, if made. It should be borne in mind that from 50 to 60 per cent. of the letters patent litigated are declared invalid for one reason or another; this certainly seems "drastic" enough without recommending that the courts go into legislation. They are sufficiently inclined that way now to suit most lawyers.

An intesesting side light is thrown on your editorial by the next but one on "High Tension Insulation," as follows:

> "At pressures of 50,000 volts * * * * * * * the insulation of the transformer leads becomes a problem even tougher than the insulation of the line * * * * * * * . Of insulating compounds having good mechanical properties and able to withstand moderate voltages, there are many; but when it comes to dealing with many thousand volts, the number dwindles to evanescence. * * * * * In the region of pressures where coronal discharge is prominent, the situation is greatly complicated and insulation is a formidable question."

Yet insulation has been applied to conductors for certainly a hundred years, and it seems that current engineering development has not been sufficient. Just here some of us feel that invention is necessary, in this old and well-ploughed field; and that when Mr. Moody or some other transformer engineer devises a solution which proves in practice a thoroughly good one, good enough to become the best practice in the art, and to stand the test of time, he would be entitled to letters patent.

The editorial seems to me to fail to distinguish scientific investigation and invention; and to omit the qualification of the statute which grants letters patent for what is "new and useful."

If it simply confined its criticism to the granting of letters patent for so-called inventions which are not useful; or to the leniency shown to those who make random sketches subsequently swelled out by the arts of the patent solicitor to dominate the ideas of those who apply the underlying physical conception to some useful work, perhaps we could all agree with it.

NEW YORK CITY. T. J. JOHNSTON.

The Foucault Pendulum Experiments.

To the Editors of Electrical World and Engineer:

SIRS:—I have read with much interest the editorial in your issue of January 30 on the Foucault pendulum, and Mr. E. K. Adams' article suggesting means for reinforcing its action. These means, though very ingenious, do not appear to be entirely practicable. For purposes of instruction and for most any purpose to which this interesting pendulum can be put, a bob of soft iron would seem to do as well as any other metal and answer the same purpose as the inside coil which is suggested. It would also be easily possible to design a mechanism magnetically sensitive to the presence of the iron bob over the central coil, whereby the switching on and off of the electric current would be done automatically.

But it is also possible to restore the pendulum energy by mechanical means without thereby disturbing its plane of vibration. Force may be applied vertically at the point of suspension by gently and regularly lowering that point a short distance during the inward and correspondingly raising it during the outward motion of the pendulum, in which case the amplitude of vibration will be preserved. A suitable clockwork might regulate this operation. To regulate it by the pendulum itself I can think of no other means than the one above referred to, unless it be through the closing of an electric circuit by the point of the pendulum dipping into mercury when passing the center.

May I presume to make a suggestion? Would it not be a good idea to have a Foucault pendulum, equipped for continuous motion, at the St. Louis World's Fair? Such an exhibition undoubtedly would be an attractive feature of the Exposition.

CHICAGO, ILL. S. TIDEMAN.

Individual Motor Drive.

To the Editors of Electrical World and Engineer:

SIRS:—In your issue of March 12 there appears a letter from Mr. H. H. Cutler, of Milwaukee, criticizing my article on "Individual Motor Drive" in the February number of *Cassier's Magazine* and abstracted in your issue of February 20. Mr. Cutler takes exception to the rules that I have laid down for the determination of the size of motors for any given application, and, according to different methods of speed control used. He attempts to elucidate in a few words the causes that produce sparking in a motor with a weakened field. The elucidation is more or less lucid, depending upon the point of view, but any engineer who has had any considerable experience in the design of direct-current motors would probably consider that he has left a good deal unsaid, and has said a good deal that perhaps bears on the subject, but to a very insignificant degree. However, it is not important to the subject in hand to know just exactly what the innermost workings are that produce the result. It is sufficient to know that the results of operating a direct-current motor with its magnetic field considerably weakened, tend to make it spark; and it is a fact that motors operated under this condition do spark to a greater or less degree, depending upon the comparative load put upon them.

Mr. Cutler has substituted for the rules that I have laid down another set of rules. I quote the third rule as follows: "The horse-power capacity under variable field strength will remain constant." It would seem that it needs no argument to prove that this rule is not a rule at all. We have only to refer to another part of Mr. Cutler's letter to see that he does not believe it himself. He says: "It is certainly true of a great many makes of motors now on the market that they will actually develop the same horse-power at

double their normal speed with weakened field, but most of them will spark badly at the commutator on the higher speeds when transmitting their rated horse-power, simply because they were designed to run at a constant speed." This quotation proves that a great many motors of the best makes have, as they should have, a certain margin under normal operation.

He states that it is only necessary to order motors specially wound in order to produce these phenomenal results. He lays considerable stress on a quotation which he received for a motor that would develop 5 hp at 300 r.p.m. with full field, and 5 hp at 1,200 r.p.m. with weakened field, without undue sparking at the commutator. This motor as normally considered was a 15-hp motor at 900 r.p.m. I have no doubt at all that he received such a quotation, as there are numerous instances in which such quotations have been made and in which such motors have been furnished; but in every case the result has been the same.

A great many designers of direct-current motors have attempted to hypnotize the motors in order to cause them to produce these results. It is not a question of who builds the motor, as Mr. Cutler suggests, because all motors will perform exactly the same if they are built with the same margins. Mr. Cutler seems to lay great stress on what he says the builders will guarantee to do, but he does not state any instances in which these guarantees have been fulfilled, nor does he state how a motor shall be designed, especially in order to meet these requirements. He does not make this statement, for the simple reason that it is not possible.

The writer knows from a long and bitter experience in the individual application of motors that these rules as given by Mr. Cutler cannot be maintained in practice. If rule three, as laid down by Mr. Cutler, could only be proven true, it would be a great boom in the individual application of motors, and not only in the individual application of motors to machinery, but to motors in general, as it would be perfectly possible to construct a motor for general purposes at a considerably less expense than is ordinarily involved; for this rule simply states that the amount of magnetic flux in the field of a motor is unimportant, and can be made anything, as it is only necessary to have some flux and as many conductors on the armature as will give the desired speed.

It does not seem necessary to criticize the other rules laid down by Mr. Cutler, as they are all based on this assumption, with the exception of the ones which refer exclusively to variable voltage.

CINCINNATI, OHIO. W. COOPER.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Pulsations of the Direct Current of Synchronous Converters.—ELSAESSER.—An article illustrated by diagrams in which the author investigates by analytical methods why the direct current taken from a rotary converter is pulsating. He endeavors to show that the main reason of the pulsations is the superposition of the ohmic voltage drop for direct current and alternating current in the armature conductors. His main conclusions are as follows: Every single-armature converter with only one armature winding for direct current and alternating current produces a pulsating e.m.f. on the direct-current side, the cause being the superposition of the ohmic voltage drops of the direct-current and alternating-current sides. Compared with this, other reasons of the pulsations are of secondary importance only. The frequency of the alternating voltage which is superposed to the direct-current voltage is twice, three times, six times the frequency of the supplied alternating current for single-phase, three-phase and six-phase converters, respectively. The amplitude of the pulsations depends upon the load and upon the pole shape of the converter. With an open direct-current circuit (that is, with no load), there is always a pulsating increase of voltage. The period of pulsation is equal to that of the loaded converter. For the single-phase converter this increase of voltage varies between zero and a value approximately equal to the voltage drop of the direct-current machine. With polyphase converters this increase of voltage is always greater than zero, but smaller than the voltage drop of a direct-current machine. It is, therefore, incorrect to determine the e.m.f. of the converter from the voltage at the terminals with open direct-current circuit. The superposition of the ohmic voltage drop of the direct and alternating-current sides also manifests itself on the alternating-current side and produces not only a distortion of the voltage curve, but also a considerable decrease of the ohmic drop of voltage. The distortion is small in the single-phase converter, but becomes greater with the increase of the number of phases. A phase difference between current and e.m.f. on the alternating-current side is generally of no great influence upon the phenomena upon the direct-current side, but manifests itself considerably on the alternating-current side.—*Elek. Zeit.*, March 3.

REFERENCES.

Circular Diagram of Induction Motors Above Synchronism.—MÜLLER.—A mathematical article illustrated by diagrams. If the rotor of an induction motor is operated above synchronism, it returns current to the supply mains. The author shows that the well-known (Heyland-Behrend) circular diagram, if applied to the operation above synchronism, gives wrong results. His calculations are made by Steinmetz's symbolic method and show, for instance, that in the non-synchronous motor the current is always lagging in phase behind the e.m.f., while in the generator it may be leading under certain circumstances. The short-circuit current for a slip + 100 per cent. (i. e., with the motor at rest) is generally much smaller than at the slip—100 per cent.—*Elek. Zeit.*, March 3.

Alternators in Parallel.—BOHLE.—The first part of what seems to be a very long paper giving a summary of the whole subject. While in the parallel connection of direct-current machines it is only necessary to have equal e.m.f., in alternators it is necessary to have equal e.m.f's, equal periodicity and phase equality. These different requirements are discussed with the aid of diagrams and the action of the "synchronous force" is dealt with. The paper is to be continued.—Lond. *Elec.*, March 4.

High-Voltage, Direct-Current Dynamo.—A note on a direct-current machine built by the Company of Electrical Industry in Geneva (Thury) for experimental work in a technical college. It gives one ampere at 2,000 volts when running at 600 to 700 r.p.m. The commutator has 96 segments, condensers being connected in parallel to the armature coils, in order to avoid sparks. The exciting current is furnished by a small 110-volt exciter.—*Zeit. f. Elek.* (Vienna), March 6.

LIGHTS AND LIGHTING.

Mercury Vapor Lamp.—An article in which it is claimed that on account of the peculiar light of the mercury vapor lamp it is suitable only for purposes in which the distinction of colors is not important; it is, therefore, especially suitable for photography without colors, etc. The old Arons lamp is distinguished from the Cooper Hewitt lamp since the former had no automatic lighting arrangement and had to be started in a somewhat complicated way. Arons stated in a recent lecture that if in his lamp the arc has a length of 750 mm., the lamp consumes a voltage of 15, and that if the length of the arc is increased, the voltage also increases by 6 to 7 volts for each 100 mm. He mentions the peculiar fact that in his lamp, consisting of a reverse U tube, with mercury in both vertical tubes, the mercury evaporates from the anode over to the cathode, until the one vertical arm of the tube is filled with mercury, which is thus made to flow over. This produces a stationary condition without disturbing the light.—*Elek. Neu. Anz.*, February 15.

REFERENCE.

Long Life of Carbon Incandescent Lamps.—A note on some carbon incandescent lamps which had a life of 14,000, 21,800 and 17,000 active hours. In the second lamp the candle-power had, however, decreased from 32 to 9 and in the third from 25 to 5. While this

long life of carbon filaments may be remarkable, it is not economical to use lamps for such a long while.—*Elek. Neu. Anz.*, February 15.

POWER.

Swiss Water Power Plant.—COLLISCHONN.—The conclusion of the long illustrated description of the Kubel water power plant. The power house contains four turbine-driven generators, each of 500 hp, two turbo-driven generators, each of 1,000 hp, and one steam dynamo of 1,000 hp. The generators have a stationary armature and a revolving field system and produce directly a voltage of 10,100. To protect the switchboard attendants against any accidents from the high voltage, the following method is made use of. All instruments, phase indicators, etc., are connected to a few coils separated from the other windings of the machine, and the voltage thereby lost, is regained by a transformer which is primarily connected to the measuring coils and secondarily to the armature winding. If the ratio of transformation of this transformer is one to one, the primary and secondary currents are equal, so that the current measured by the instruments is equal to that of the machine. The e.m.f. measured at the instruments is to be multiplied with the ratio of the number of coils of the armature to that of the separated coils; the voltmeters are, of course, calibrated so that they give at once the voltage of the machine. A map is added which shows the distribution of power from the station. There are two main lines from which go off several branches; the most distant point is at a distance of about 23 km. from the plant. There are about 900 consumers of lighting current with a consumption equivalent to 17,000 lamps of 56 watts. There are connected to the plant 47 motors with 1,602 hp capacity, while 126 kw are used for 242 heating apparatus. In order to encourage consumers to use current for power purposes, four different tariffs have been devised to suit every possible customer.—*Elek. Zeit.*, March 3.

Electric Power in Ship Yards.—BROWN.—An illustrated article on electric power in British ship yards, with special references to the northeast coast. From figures supplied by a shipbuilding firm which adopted electric driving in its early stages, he gives a comparison of the cost of power per "pound of wages paid" in the years 1894 and 1901; that is to say, before and after the use of electricity. In 1894 the cost for coal, gas and labor for driving the engines scattered around the yard was 8.66 pence per "pound of wages paid," and in 1901 the cost of coal, labor and other incidentals for producing the power electrically, was 4.88 pence per "pound of wages paid," or, in other words, the wages paid in 1901 were practically double those paid in 1894, and the cost for power was the same, and this in spite of a very great increase in the number and size of the machine tools employed, which, in the year in question, practically amounted in 1901 to six times what were in use in 1894. There are three systems in use; in the older ones 125 volts direct current is employed, in later ones 220 or 250 volts direct current, and some of the very latest installations employ three-phase currents at 400 to 440 volts. There is some advantage in the use of three-phase currents over the direct-current system, especially if a higher pressure than 250 volts be required, in view of the difficulty of lighting the offices from a two-wire, direct-current system at a higher pressure than 250 volts; but on the score of simplicity there does not seem to be any advantage on one side or the other, and though the question of maintenance naturally arises, as far as could be gathered from works with direct-current systems in use from 8 to 9 years, only a small amount of attention is required to the commutators and brushes. The principal repairs in both direct and alternating-current systems are in connection with the starting systems and regulating apparatus. The author describes several installations and the equipment of various machine tools.—*Cassier's Mag.*, March.

Engine Tests and the Effect of Superheating.—MORCOM.—A paper on the equipment of an engine test house, as used by manufacturers for their own purposes, as well as to demonstrate guarantees, so as to avoid the inconvenience to a station engineer of having his station turned into an experimental apartment. A plant for testing combined sets for electricity stations is described, the general routine of such tests is given and special notes are added on temperature tests, exhaust, brake tests, the instruments and apparatus used, switchboards, and the benefit due to superheating. Concerning the latter point he says that on an engine properly designed to run under superheated steam conditions full advantage is taken of the improved economy with but little extra trouble in running. It is only in using superheat on an engine quite unsuited for the purpose that troubles are experienced. The point has sometimes been raised, that as clearance for expansion must be allowed in the pistons and valves on an engine designed for superheat, so if the superheat fall the engine will be very extravagant of fuel. Experiments have been made which prove that this is a mistaken notion. An engine designed to run with 250° superheat has been tested with dry steam at saturation temperature and the result shows that with these valves and pistons the engine is only 2.1 per cent. less economical than when fitted with valves as pistons designed for ordinary conditions. With a three-cylinder triple engine of 200-kw capacity, the steam consumption in pounds per hp-hour was determined as function of the degrees of superheat, and it was found that the percentage of improvement for any given rise in temperature is approximately the same at full and half loads. The gain due to 200° of superheat was found to be 41 per cent. The actual gain due to superheat is, of course, less than this, as extra lubrication and increased fuel consumption are required. The increased cost of oil for cylinder lubrication amounts to about 0.08 cent per 100 hp-hour, and is, therefore, a very small item. Fuel consumption trials run on a 522-hp triple-expansion engine with 160 pounds pressure and 26-in. vacuum gave the following figures: Fuel per hour with saturated steam, 1,193 pounds; in boilers with superheat, 833 pounds; in superheater to give a temperature of 600°, 173 pounds. Accordingly, the gain in fuel is 19 per cent. The fuel was slack of poor evaporative value. The superheater was very lightly loaded, and the lagging of the steam pipe was not so good as it might have been. Allowing for these points, it seems that a saving of, say, 25 per cent. might be expected by superheating to 600°. Another interesting trial taken on a 120-hp compound engine at 450 r.p.m. was on the influence of forced lubrication on the indicated horse-power at light loads. The engine was run free, and friction cards taken with oil pressure of 30 pounds, 5 pounds and 0 pound. The horse-powers in each case were 2.128, 2.409 and 3.333, respectively. This is interesting as showing that a great increase in oil pressure will not bring a correspondingly big advantage.—Lond. *Elec.*, March 4.

REFERENCES.

Earth Return in Direct-Current, High-Tension Transmission Systems.—An illustrated note stating that Thury made some years ago experiments in order to use the earth as return in his well-known direct-current series system. If in such a system the earth is used as return, 15 per cent. of copper weight is saved for the same percentage loss, or, if the same copper is used, the losses are reduced to one-quarter of their original value. The resistance of the earth is negligibly small for industrial currents. Only the contact resistances are to be taken into consideration; by proper arrangements they may be reduced at will (for instance, to one ohm). Recently Thury has suggested an arrangement in which the earth is used as the neutral wire in a high-tension, direct-current, three-wire system. —*Zeit. f. Elek.* (Vienna), March 6.

Labor Saving by Power Applications.—The whole number contains profusely-illustrated articles on this subject. Hunt writes on the world's great labor-savers and labor-servers from James Watt to George Westinghouse; Rose on the rise of labor through labor-saving machinery; Sweet on the prime-mover and its influence on the world's progress; Waitt on labor-saving devices as the basis of the railway's growth; Baxter on hydraulic appliances in the engineering industries; Moldenke on labor-saving machinery in foundry operations; Robertson on the development of power-driven machinery in mines; Bolton on mechanical auxiliaries to the economy of the fire room, and L. Bell on the relation of electrical inventions to human activity.—*Eng. Mag.*, March.

Steam Turbine.—PORTE.—An illustrated paper read before the Dublin Section of the Brit. Inst. Elec. Eng. describes the construction and operation of the De Laval steam turbine.—Lond. *Elec.*, March 4.

TRACTION.

Swiss Railway.—The conclusion of the long and well-illustrated article on the electric railway between Freiburg, Morat and Anet. The third rail is used along the line, except at street crossings and in railroad stations. The third rail is placed alternately at the left side and at the right side of the track. There are, of course, two sliding contacts on the train, one on each side. The two sub-sta-

tions supply the third rail by an underground cable, the road being divided into three sections which may be supplied with current or disconnected at will from one or the other station. The equipment of the cars is described in detail.—*L'Eclairage Elec.*, March 5.

Single-Phase Traction.—EICHBERG.—The conclusion of his paper on single-phase railroads. The author gives several diagrams in comparing the behavior of two 600-volt, direct-current motors with that to two 6,000-volt, single-phase motors, based on the experimental runs with the Winter-Eichberg motor near Berlin. He concludes that the single-phase motor is able to fulfill the most rigid requirements of traction.—*Zeit. f. Elek.* (Vienna), March 6.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Voltage Regulation in Alternating-Current Systems.—MEYER.—The conclusion of his paper, the first parts of which have already been abstracted in the Digest. He discusses automatic voltage regulation and compounding. The first method dealt with is by means of mechanical influence on an exciter rheostat, which is shown in

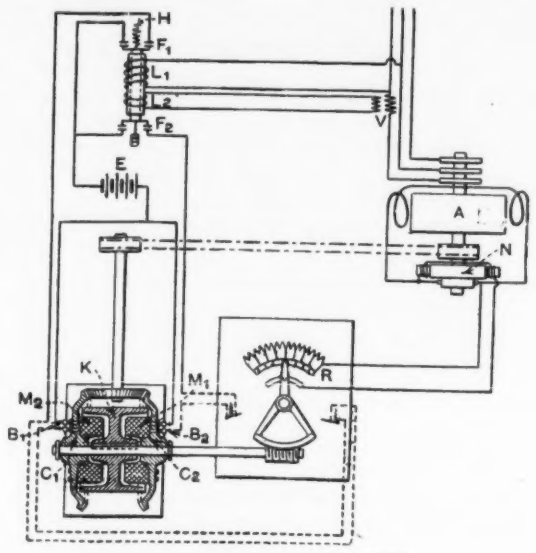


FIG. 1.—VOLTAGE REGULATION.

Fig. 1. *A* represents the alternator, *N* the exciter, *R* is the rheostat in the exciter field. Its handle is worked by means of a worm gearing from a magnetic clutch, *K*, which is controlled by the relay, *L*. The latter device is shown as a solenoid acting against a spring. In accordance with a lower or higher supply voltage either the spring or the solenoid will be more powerful, thereby closing the energizing circuit of M_1 or M_2, thus increasing or reducing the resistance, *R*. By adding a second coil, L_2, wound in opposition to L_1, and controlled from the secondary of a current transformer, *V*, the primary of which is in series with one of the main lines, overcompounding with increasing current can be obtained. This scheme has been successfully used in a number of plants where the nature of the load introduces only very gradual changes in load. For all other purposes it is not recommended, since the time lag between action and reaction is too much to allow a satisfactory regulation of the voltage. A second method is the use of a pulsating excitation in the exciter field. The device of Tirril, of the General Electric Company in America, belongs to this class. In the same the control of voltage is obtained by rapidly opening and closing a shunt circuit across the exciter field rheostat, thus giving the exciting current of the exciter a more or less pulsating character. The frequency of the make and break of this circuit is controlled by the voltage and, if desired, also by the current of the generator, and varies from about 1 to 20 per second. The apparatus is described in detail. It is well known in this country since more than 100 of these regulators have been installed here within the last 18 months. A third class of regulation is by means of influence on the armature reaction of the exciter. The compensated generator of the General Electric Company, of this country, of which about 3,000 kw are in successful use in sizes from 50 to 500 kw, belongs to this class, as also does the compound generator with special exciter of Le Blanc, which was exhibited at the Paris Exposition. However, the complications inherent to the arrangement of the latter have apparently prevented its commercial introduction. The fourth method discussed by the author is compounding by means of rectified or low periodicity alternating currents. Older arrangements of the General Electric Company and the Westinghouse Company and Ganz & Co. belong to this class. These alternators are provided with a commutator and a series winding on the field in a manner similar to compound-wound, direct-current generators. The new arrangements of Latour and Heyland also belong to this class.—Lond. *Elec.*, March 4.

Water Resistance.—MORCON.—In a paper on the equipment of an engine test house the author says that after considerable trouble and expense in connection with wire resistances both in wooden and iron frames, the following form of water resistance for taking up the load was devised: The poles are of iron, arranged in wooden tanks. Water from a neighboring canal is passed continually through the tanks by a bye-pass on the condenser circulating pump, and flows out over a weir. The poles are connected to a load-adjusting switchboard, and can be coupled into the load in many combinations. Three tanks are used for different ranges of voltages, and these ranges are further divided by adjustments of the outflow from the tank. Specially subdivided tanks are used for polyphase work. The first experience when using a water resistance was not very satisfactory. The apparatus consisted of an iron tank about 3 ft. wide and 6 ft. long, with two large iron plates for the electrodes. This tank did not last very long, for the current, as well as passing from plate to plate, found a shorter passage by way of the sides and bottom of the tank. An improvement of this arrangement was a large wooden tank 4 ft. wide by 10 ft. long and about 4 ft. deep. Into this were fitted four hollow cone-shaped castings, large and upwards. Inside each of these cones was a smaller one, suspended from above on a screwed spindle and hand wheel. The outer cone was coupled to one terminal of the dynamo on test, and the inner through a flexible lead to the other terminal. Load could then be varied by raising or lowering the inner cone on the screwed spindle. It was necessary to keep the water level a little higher than the top edge of the outer cone, so that the heated water in the space between the cones might rise naturally and flow away. This arrangement gave very satisfactory results; in fact, some cones are still in use which were fitted about 18 months ago. For higher voltages it was proposed to use a metal rod dipping into the water at the center of the cone, but the conducting area of water to the outer cone was too large and the length of water resistance too small for many machines. Accordingly, a wooden trough of small cross-section and great length was designed for high-voltage work. The use of wooden troughs did away with the need for conical poles, and it is now found more useful to substitute iron plates fixed at the top to flexible terminals and movable on insulated rollers along wooden runners. The load can thus be varied by sliding the plates along so that the cross-section between them is varied. By using a considerable number of smallish plates a very flexible load is obtained, and if care be taken with the circulating arrangements a very steady load results.—Lond. *Elec.*, March 4.

ELECTRO-PHYSICS AND MAGNETISM.

Thermoelectricity of Iron and Steel.—BELLOC.—A paper presented to the French Association for the Advancement of Science. Concerning the temperature coefficient of the thermo e.m.f. of steel-platinum couples (comprising the Peltier and Thomson effects) he arrives at the following conclusions: The curves representing the same show a minimum common to all couples near 380°, the minimum being 8.75 microvolts. All curves reach a maximum at a higher temperature, but the position of this maximum depends upon the contents of carbon in the steel; the temperature at which the maximum occurs varies between 680 and 820° and the maximum itself between 16 and 20 microvolts. Each curve shows afterwards another minimum at a temperature about 120° above the temperature at which the maximum takes place, and the second minimum differs from the maximum of about 4 microvolts.—*L'Eclairage Elec.*, March 5.

Selenium Cells.—BERNDT.—An account of experiments in which the author reaches the conclusion that the decrease of resistance of a selenium cell, when lighted, cannot be explained by a chemical action. He offers the hypothesis that crystalline selenium exists in two modifications which are in dynamic equilibrium with one another. When the cell is lighted this equilibrium is changed, but in the dark the original condition is gradually brought back. If, however, the cell is roughly handled, then so much is formed of the one modification that a part of it assumes a stable state of equilibrium and does not return to the former condition in the dark.—*Phys. Zeit.*, March 1.

Energy of Röntgen Rays.—WIEN.—Of all hypotheses on the nature of Röntgen rays the author considers as the most plausible one that of Wiechert that they represent electromagnetic oscillations of short duration, caused by the quick retardation of the negative electrons hitting the surface with great speed. On this basis the author calculates the energy of Röntgen rays, making special assumptions. If in a discharge tube 0.001 amp. electricity is transported in the cathode rays, this makes 4.1×10^{15} electrons per second, and the total energy changed into Röntgen rays is 0.000125 watt. Since the radiation of a theoretically black body of 100° C. to one of 0° with 1 sq. cm. surface is 0.073 watt, the energy of the Röntgen rays is about 500 times more.—*Phys. Zeit.,* March 1.

Polarization of Röntgen Rays.—LIEBEN.—The author had formerly investigated the effect of Röntgen rays upon heavy metals in the vacuum. Since Blondlot has found that every Röntgen ray tube emits polarized N-rays, Lieben has now investigated whether these N-rays have any influence on the effect found in his former work and attributed to Röntgen rays. For this purpose he eliminated the N-rays by interposing a layer of water of 3 mm. thickness. This acts as a filter, absorbing the N-rays, but allowing the X-rays to pass through. He obtained the same results as before, so that his former results were not influenced by the N-rays. He found, however, that his former observation of the polarization of Röntgen rays was wrong, being due to improper arrangement of his former experiments.—*Phys. Zeit.,* February 1.

Electrodeless Ring Currents.—HÆRDEN.—An account of experiments in which he used an evacuated electrodeless tube, filled with mercury vapor, the pressure of the vapor having such a density that about 5,000 volts were necessary to obtain a light effect in the tube. Some windings of a cable were placed around the tube and the oscillating discharges of a condenser of about 0.004 microfarad were conducted through them. On the other side of the condenser, which was charged with an alternating current of about 35,000 volts, there was a mercury air-gap, the other connections being as usual. When set into operation the tube showed a strong light effect and the glass became heated. In other words, the lamp behaved as though 5 to 6 amp. direct current were passing through it. He shows, however, that any currents directly induced in the mercury vapor are of very little importance for the phenomenon which is rather an electrostatic one, the high e.m.f. due to the impedance of the primary windings charging the glass tube on the outside and influencing a charge on the inside of the tube. These inside charges afterwards discharge through the vapor and cause the lighting. In another article he describes an arrangement in which a pure induction effect is produced and no static phenomena take place.—*Phys. Zeit.,* February 1.

REFERENCE.

N-Rays.—CHARPENTIER.—An account of experiments in which he found that the transmission of N-rays can be accomplished not only by conducting substances, but also by bad conductors such as glass and wood, although to a somewhat smaller extent. He has, in conjunction with Blondlot, even succeeded in transmitting the fluorescence across an air-gap between two condenser plates.—*Comptes Rendus,* February 5; abstracted in Lond. *Elec.,* March 4.

ELECTRO-CHEMISTRY AND BATTERIES.

Dielectric Constants.—SCHLUNDT.—In former investigations of a great number of inorganic solvents he had tested the Nernst-Thomson rule, according to which a close parallelism exists between the dissociating power of solvents and their dielectric constants. He found a number of exceptions to the rule and a number of new examples which followed the rule. The solvents studied at that time, however, follow the rule in a general way, although the parallelism between the ionizing power and the dielectric constant was far from close in several instances. The author has now investigated the dielectric constants of some halogen compounds of phosphorous, arsenic and antimony. The value for the dielectric constant for the compound in the solid state is less than the value for the liquid and the structure has a great influence on this difference. Most of the compounds studied follow the Nernst-Thomson rule.—*Jour. Phys. Chem.,* February.

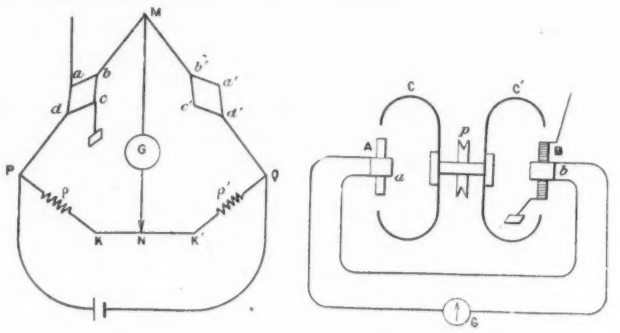
Storage Battery.—A note on the Lacroix storage battery, made by a French company. The wire of the very fine webbed network from which the plates are made consists of a special alloy, called pontinium and consisting of a thousand parts of lead, 15 parts of tin and 1 part of sodium. In spite of the very thin but nevertheless very resistant network of the plate, the active mass is claimed to be kept very firmly in it, so that it can drop out.—*Elek. Neu. Anz.,* February 15.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Electrical Methods of Measuring Temperature.—CALLENDAR.—An abstract of a lecture in which he said that the electrical methods for measuring temperatures are more accurate, speedy and generally convenient than the other methods yet known, and are at the present time used almost exclusively in research work. There are two kinds of electrical methods, one based on measuring the resistance due to the change of temperature and the other on measuring the potential difference at the junction of two different metals when it is heated. The first method is more accurate, as a rule, than the second, especially for low temperatures, and has the further advantage of giving readings almost instantaneously. It is also very convenient for measuring mean temperatures. The second method, using a thermo-couple, is valuable for determining the temperature at a particular point. He discussed briefly the methods for determining resistances, pointing out the great accuracy of the zero methods, and drew special attention to the proper way of connecting up the very fine platinum resistance wire of the thermometer to the resistance box. The proper way to do is to make the connections so that the current passing through the resistance wire of the thermometer also passes through the resistance in the third arm of the bridge. The current passing through the wire is thus small, and the error due to its heating the wire is reduced to a minimum. He described an electrical temperature recorder which may be used for various purposes; for instance, for recording the duration and intensity of sunshine. It is much more sensitive than the burning-glass method, which is generally used for this purpose.—Lond. *Elec.,* March 4.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Electric Wave Detector.—TISSOT.—A paper presented to the French Association for the Advancement of Science. The author has found that the bolometer may be used as a detector of waves over a distance of several kilometers. His arrangement, shown in Fig. 2, consists essentially of two identical systems of thin platinum wires, *a, b, c, d* and *a′, b′, c′, d′*, arranged on the branches of the Wheatstone bridge, *M, N, P, Q*. The bridge is brought into equilibrium by means of the two coils, *S* and *S′*, immersed in the same bath of petroleum, and connected together by the sliding contact, *K, K′*. The vertical wire is connected to *a*, and *c* is connected to earth. A sensible galvanometer is used in *G*. The author uses one of the Thomson (Broca-Carpentier) type, the coil of which has a resistance equal to that of the other branches of the bridge. The quantity measured is the total energy received by the vertical wire. For other purposes the author has employed a modification of the Rutherford-Marconi magnetic detector. Observations are made by a galvanometer, instead of a telephone. The instrument, shown in Fig. 3, consists essentially of a double detector, each consisting of a magnet, *C* and *C′*, a primary coil (*A* and *B*) with steel wires and a secondary coil (*a* and *b*). The magnetic, *C* and *C′*, are mounted on the same axle. The coils, *a* and *b*, are connected in opposition to a sensible ballistic galvanometer, *G*, or to an electrodynamometer of the Bellati type. The arrangements are so made that there exists perfect equilibrium of *G* during the rotation of the system. This equilibrium is destroyed by the arrival of an electric wave if the coil, *B*, is connected at one end to the vertical wire, and with the other end to earth.—*L'Eclairage Elec.,* March 5.



FIGS. 2 AND 3.—ELECTRIC WAVE DETECTOR.

REFERENCE.

Type-Printing Telegraph.—LINDLOW.—An illustrated description of the Steljes type-printing telegraph, a characteristic feature of which is the use of alternating current.—*Elek. Zeit.*, February 25.

MISCELLANEOUS.

Cure of Cancer by Radium.—WALSH.—An article in which the author states that while it is not yet possible to speak with certainty as to the exact therapeutic value of radium, yet he is confident that by its means it is possible to modify profoundly and in some cases apparently to cure surface rodent ulcers and epitheliomata. The method of application is to enclose the radium in a small India rubber capsule with a mica window or in a small glass tube. The radium is used most conveniently in the form of the bromide and should be of good quality. The small tube containing the salt must be placed directly in contact with the ulcerating surface. It apparently is of no use if applied to the unbroken skin surface. The action of the radium is strongest at the immediate point of contact and lessens in power according to the distance from that point of contact. The radium may be applied for a quarter of an hour or more up to 30 or 40 minutes, but the length of application should be most carefully regulated by individual results. A reaction occurs usually on the eighth day of treatment and may be due to the formation of an antitoxin. The radium cure has even been applied to a rapid malignant invasion of the upper throat. Four small sealed tubes with radium bromide were fastened at the end of a curved holder and enclosed in a covering of India rubber extemporized from a finger stall. The throat was then cocainized and a gag inserted between the teeth. A light thrown into the mouth by a mirror enabled the physician to pass in the radium and press it with decision on the desired part. By this treatment the ordinary process of the disease has been profoundly modified, if not, as is hoped, even been arrested.—Lond. *Elec.*, March 4.

REFERENCE.

Biographical.—A sketch, with portrait, of P. M. Lincoln, of the Westinghouse Company.—*Cassier's Mag.*, March.

New Books.

MY AIR SHIPS. By A. Santos-Dumont. New York: The Century Company. 400 pages, 75 illustrations. Price, $1.40.

This is not exactly a scientific treatise on aerial navigation, nor does it profess to be. It is rather a chronicle of successive attempts to solve some of the many problems connected with the subject, including more particularly those of dirigibility, and incidentally one picks up a lot of practical information from the narrative unfolded in these simple and direct pages. Mr. Santos-Dumont has, indeed, achieved no small measure of success from his courageous and persistent efforts, and one wonders that the young Brazilian is really alive to tell the tale. The probability is that had he been a few pounds heavier he might not have traveled so fast and so far in the air, modern flying, like modern fighting, being distinctively in favor of the small man. In these later attempts at airship steering, electricity does not play so much of a part as it did, for example, in some of the earlier work of Krebs and Renard, and the Tissandier Brothers, who employed motors and accumulators; but in real hard work the turn of electricity may come again. Mr. Dumont makes incidental reference to his conference with Mr. Edison on the subject.

LA TECNICA DELLE CORRENTI ALTERNATE. 2 volumes. By Guiseppe Sartori. Milan: Ulrico Hoepli. Vol. I, 336 pages, 260 illustrations; price, 8 lire. Vol. II, 495 pages, 293 illustrations; price, 12 lire.

These two volumes taken together form the best text-book on alternating-current theory and practice that we have yet seen in the Italian language. The writer has a clear and descriptive style. There are abundant illustrations, diagrams and numerical examples.

Volume I is written on the practical side of the subject, with curves, diagrams and illustrations of machinery, but with scarcely a single algebraic equation. The subjects treated are single-phase and polyphase currents, induction coils, transformers, alternators, synchronous and asynchronous motors, both single-phase and polyphase, converters and transmission lines. The information given is simple, definite and reliable.

Volume II is devoted to the engineering mathematics or technical algebra and arithmetic of the same subject. In this direction vector methods and diagrams are plentifully introduced. The treatment is excellent and clear. A number of numerical examples are scattered throughout the work.

The first volume is well adapted for study by those who are not interested in the quantitative relations of the subject. The second volume is an excellent text-book for students of alternating-current engineering. To all interested in this subject and to whom the Italian language is familiar, the work is to be strongly recommended.

THE UNIVERSAL ELECTRICAL DIRECTORY. By J. A. Berly. London: H. Alabaster, Gatehouse & Co. 1,446 pages. Price, 10s.; U. S. A., duty free, $3.75.

This valuable publication has now reached its twenty-third year of annual issuance, and has again been thoroughly revised and brought up to date. The sections are as usual: Continental, United States, Colonial and General, British, and Geographical, each alphabetical list of names being accompanied also by a classified list as to manufacturers, engineers, etc., so that the finding can be easily accomplished in connection with any name wanted. The American list is very full and complete and is valuable also by giving telephone calls or cable addresses. In fact, one feature of value of the book is the number of cable addresses given in connection with all the lists of names. The book has now reached a total of nearly 1,500 pages, large octavo, a simple fact which will convey an idea of the immense amount of work put upon the compilation. The preface discussing the outlook does not speak very cheerfully with regard to the past year in England, but is a little more hopeful with regard to the outlook during the present year. It points significantly to the fact that electric traction is beginning to boom, not merely with regard to street railway enterprises, but those of larger range and scope. England is indeed an ideal country for the conversion of short trunk railroads from steam to electricity, and although the conservatism of the country is notorious and is a good factor in a great many instances, it is hard to believe that it can stand much longer in the way of this needed change of motive power. England is a country where steam locomotion has been of inestimable value, but has brought in its train a great many evils, some of which electricity can certainly cure or ameliorate, to say nothing of its own inherent advantages not possessed by its elder competitor.

BOOKS RECEIVED.

THE LOCALIZATION OF FAULTS IN ELECTRIC LIGHT AND POWER MAINS. Second Edition. By F. Charles Raphael. New York: D. Van Nostrand Company. 205 pages, 112 illustrations. Price, $3.00.

TESTING OF ELECTROMAGNETIC MACHINERY AND OTHER APPARATUS. Vol. I. By B. V. Swenson and B. Frankenfield. New York: The Macmillan Company. 420 pages, 95 illustrations. Price, $3.00.

VORLESUNGEN ÜBER TECHNISCHE MECHANIK. By Dr. Aug. Foppl. Leipzig: B. G. Teubner. 471 pages, 176 illustrations. Price, 10 marks.

FREE-HAND LETTERING. By Victor T. Wilson. New York: John Wiley & Sons. 95 pages, 13 illustrations. Price, $1.00.

THE METRIC FALLACY. By Frederick A. Halsey and Samuel S. Dale. New York: D. Van Nostrand Company. 231 pages. Price, $1.00.

ENTROPY; or, Thermodynamics from an Engineer's Standpoint, and the Reversibility of Thermodynamics. By James Swinburne. Westminster: Archibald Constable & Co. 137 pages. Price, 4s. 6d. net.

MODERN WIRING DIAGRAMS AND DESCRIPTIONS FOR ELECTRICAL WORKERS. By Henry C. Horstmann and Victor H. Tousley. Chicago: Frederick J. Drake & Co. 154 pages, illustrated. Price, $1.50.

THEORIE UND ANWENDUNG DES ELEKTRISCHEN BOGENLICHTES. By H. Birrenbach. Hannover: Gebruder Janecke. 350 pages, 266 illustrations. Price, 9 marks.

AMERICAN TELEGRAPHY AND ENCYCLOPEDIA OF THE TELEGRAPH. By William Maver, Jr. New York: Maver Publishing Company. 656 pages, 490 illustrations. Price, $5.00.

CARE AND HANDLING OF ELECTRIC PLANTS. By Norman H. Schneider. New York: Spon & Chamberlain. 104 pages. Price, $1.00.

PHENOMENES FONDAMENTAUX ET PRINCIPALES APPLICATIONS DUE COURANT ALTERNATIF. By R. Swyngedauw. Paris: Ch. Dunod. 174 pages, illustrated.

Steam Boilers; Their Theory and Design. By H. deB. Parsons. New York: Longmans, Green & Co. 375 pages, 155 illustrations. Price, $4.00.

A Treatise on Friction and Lost Work in Machinery and Millwork. By Robert H. Thurston. New York: John Wiley & Sons. 430 pages, 77 illustrations. Price, $3.00.

Electric Traction. By John Hall Rider. London: Whittaker & Co. 442 pages, illustrated. Price, $3.00.

American Meter Practice. By Lyman C. Reed. New York: McGraw Publishing Company. 196 pages, 78 illustrations. Price, $2.00.

Die für Technik und Praxis Wichtigsten Physikalischen Grossen. By Olof Linders. 396 pages, 43 illustrations. Price, 10 marks.

Technical Mechanics. By Edward R. Maurer. New York: John Wiley & Sons. 382 pages, 250 illustrations. Price, $4.00.

National Electric Light Association. Twenty-sixth Convention. Published by order of Executive Committee. New York: James Kempster Printing Company. 1221 pages, illustrated. Published for members only.

Machine Design. Part II. By Forrest R. Jones. New York: John Wiley & Sons. 426 pages, 243 illustrations. Price, $3.00.

Electro-Ingenieur-Kalender. 1904. By Arthur H. Hirsch and Franz Wilking. Berlin: Oscar Coblentz. 279 pages, 2.50 marks.

Kalender für Elektrochemiker. 1904. Beeloge zum Kalender für Electrochemiker. By Dr. A. Neuburger. Berlin: M. Krayn. 575 pages.

Luftverunreinigung und Ventilation. By Dr. Josef Rambousek. Liepzig: A. Hartleben. 244 pages, 48 illustrations. Price, 7 marks 50 pfennigs.

Les Chemins de fer Electriques. By Henri Marechal. Paris: Ch. Beranger. 596 pages, 516 illustrations.

The New Epoch as Developed by the Manufacture of Power. By George S. Morison. Boston: Houghton, Mifflin & Co. 134 pages and portrait. Price, 75 cents.

Leçons D'Electrotechnique Generale. Professees a L'Ecole Superieure D'Electricite. By Paul Janet. Second Edition. Vol. I. Paris: Gauthier-Villars. 369 pages, 165 illustrations.

Electrical Trades Directory. 1904. London: *The Electrician* Printing & Publishing Company. Price, $5.00.

Alternating Currents: Their Generation, Distribution and Utilization. By George T. Hanchett. New York: John Wiley & Sons. 180 pages, illustrations. Cloth. Price, $1.

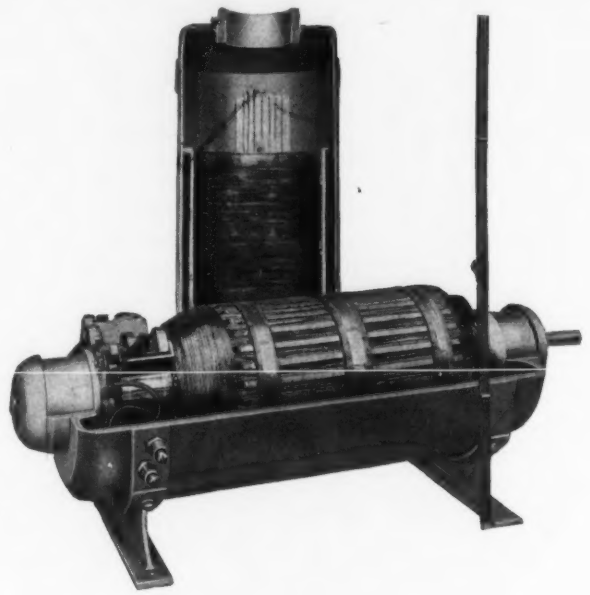
The Dialt Motor.

By N. H. Edgerton.

NOW while public attention is turned to alternating motors for single-phase circuits, and especially for street cars, interurban and very long-distance work, the following description of a motor that embodies a rather novel departure from the ordinary lines of modern construction may not be without interest. This motor, which is now just appearing commercially under the name "Dialt," did not in its early stages have the advantages of great mechanical skill, nor has it had the admirable engineering touch of Mr. Lamme, yet I am convinced that it is laid upon lines that will add materially to the perfecting of the electric motor for nearly all practical purposes.

The distinctive features are that it employs a wireless field; that each field is completely isolated magnetically from every other field, and that with a given potential it will operate on any current, with little regard to quality or condition.

The construction is exceedingly simple. A preferred form is to have the cylindrical frame of diamagnetic metal, divided into two halves, longitudinally through the axis, hinged together at the back, and suitably locked in front. In each one of these semi-cylinders is fastened half of the field equipment, whether it be bipolar or multipolar. At each end of this frame a suitable bearing is arranged so that the center of the armature shaft shall be the central line of the structure. This allows of the easy withdrawal and replacement of the armature, as the bearings also divide on line; the cups being carried in the upper half of the shell, thus exposing the shaft journals when the top is thrown back. The fields themselves are formed of circular laminations of soft steel or charcoal iron of suitable gauge insulated from each other in the usual manner or by tinning. When this latter method is employed, the laminæ of each field may be assembled together and sweated into one piece; laminated as to its magnetic function, but solid as to its mechanical structure. The question as to whether this tinned construction of the field gives rise to eddy currents therein, will have to be answered at a later day, but as the whole surface is subjected at all times to the same magnetic stress, it would seem from a theoretical standpoint that the inequality of magnetization necessary to produce such currents is wanting. Should it be found, however, that eddy currents are developed, the ordinary method of insulating the laminæ can readily be adopted. When the lid is closed down about the armature, it will be observed that with all the fields of the same dimensions and the armature wound symmetrically, there will be contiguous to, and operative upon, each field, exactly the same number of armature turns. Consequently, with any given current flowing through the armature the ampere-turns will



DIALT MOTOR.

likewise be the same and the resulting magnetization of each field the same and likewise the reaction of each field upon the armature the same.

Observing it first as a direct-current motor, we find that this construction frees us at once from two very important conditions. The first is that, having no windings, the fields are capable of being used on any voltage without change; that is to say, if it becomes desirable to change from a higher potential, say, of 550 volts to 220 or 110, or even 50 volts, or visa-versa, it is only necessary to rewind or obtain an armature of that voltage, leaving the frame fields without change. The second is that there can be no short-circuiting or burning out of the field coils or any complications between the field and armature circuits, which will happen even in the best equipments as at present installed. This feature will undoubtedly interest all those having motors under heavy service on rough roads and in all conditions of weather.

As the windings of the armature are parallel with the shaft and the laminations of the fields are at right angles thereto, it is also obvious that the armature coils are in the best position for making an electromagnet out of each separate laminæ and consequently a compound electromagnet of great power out of the assembled laminæ.

As a corollary, this machine will act as a generator for direct current, building up and energizing itself from the residual magnetism of the fields, without making any change except to swing the brushes to the opposite point of commutation or else (letting the brushes stand in the same place) drive the machine in the opposite direction. The reason for this is that by isolating the fields, so arranged, the action of the armature coils on the fields is localized, or, so to speak, concentrated in the fields themselves and not dissipated and lost in the yoke; in fact so sensitive are the fields to the armature current that I have seen an armature weighing 100 pounds wound for 88 volts and 30 amp. start up under the application of 4.5 amp. at 10 volts, or 45 watts, and run at 250 turns on 25 watts, equal to an expenditure of one watt for every 10 revolutions. It will be noted that as the

armature circuit is the exciting circuit of the fields also, and that any increase of the armature current and magnetization, will be followed by equal increase in field magnetization, the motor has the chief characteristics of a series motor, namely, variable speed with variable load, but of course without the wire losses of the field windings due to resistance counter e.m.f., etc.

The armature may be any one of the usual forms, either ring, drum or barrel, either toothed or plain, providing the windings of the armature are parallel with the shaft as mentioned above. A preferred form is to have the teeth cut in the form of an acute equilateral triangle, with the apex of the angle in the circumference of the armature and even with the outer layer of wire. The reasons for this are, first, to present to the field the greatest number of ampere-turns so as to realize the maximum magnetization of the fields; and, secondly, to minimize the iron loss in the armature due to the bunching of magnetic lines on the edges of the teeth, especially when using alternating current.

It will be seen from the foregoing description that this construction supplies a motor for direct current having series characteristics and especially well adapted to varying loads, because the current increases automatically with the load, the magnetization with the current, and the torque as the square of the current.

It is not, however, till we take up the motor to apply it to the alternating current that the full significance of its peculiarities dawn upon us. We have seen above that the field construction is such that it is independent of the armature windings so far as potential of current utilized by the armature is concerned; that is to say, if you take two armatures of equally good mechanical construction, one of which is wound for ten volts potential and the other for ten hundred or any intervening potential, and supply the required current to them, replacing one by the other alternately within the fields, the operation of the one will equal that of the other per watt energy employed. This discloses the fact that the armature is the controlling member of the combination and that the field adapts itself to, and responds automatically to, the conditions for the instant existing in the armature.

Take now an armature that has been running on the 110-volt direct current with its proper fields and supply it with 110 volts single-phase, alternating-current within the same fields; without having even changed the plane of commutation the motor will rotate as smoothly and evenly as with the direct current and the torque will be in the same direction, but will change by changing the position of the brushes. Now, supply two-phase currents to the same potential and the same result is obtained, and so also with other polyphase currents and for the reason stated, that the field responds instantly and automatically to every change of current condition in the armature. The value of this proposition in electrokinetics cannot well be overestimated. Especially is this the case in electric traction. For example, the instance narrated in a late number of the *Street Railway Journal* (and there are many such) where an aggregation of trolley companies combined their interests for the completion and operation of a long-distance line, using their individual plants over their individual roads and compelling their passengers to change cars at their termini. This transfer nuisance would be entirely done away with by such a motor, as the cars could then be run from section to section over the whole road.

As the question of the weight of the single-phase alternating motor is receiving considerable attention, it might be well to state that the Dialt motor is lighter in construction per unit of horsepower developed, for the following reasons: First and principally, because the large annular laminated ring-yoke uniting all the pole pieces is omitted entirely, while the radial depth of the poles themselves is limited to about that used for the field winding in the single-phase motor. There is, therefore, a saving in weight of the entire laminated annulus from which the pole pieces project, and this in large machines is a matter of considerable moment. In the armature there is probably no saving in weight, for the armature of the Dialt motor being relied upon to fully magnetize the field, is allowed a third more ampere-turns than in the ordinary field-wound, direct-current machine, it having been found that this increase is sufficient to insure saturation of the fields at 40 per cent. overload. There is also an elimination of the entire weight of the field windings, whatever that may be, which still further lightens the construction of the Dialt motor.

Both these motors then have reached the same result, namely, satisfactory operation on the single-phase current, but by different ways. They are also in many respects similar. We find in both the same extra-sized powerful armature, the same disposition of the poles about the periphery of the armature, and the same careful lamination of the pole pieces; each one is designed in its own way to produce the same result; that is, the concentration of magnetic energy on the faces of the pole pieces, the one doing it by means of toothed or grooved fields wound with their appropriate field coils and energized by current through those coils; the other, the Dialt, accomplishing the same result by smooth-faced unwound fields, each one isolated from all the others and energized by the current flowing through the armature coils. The one is based upon carefully observed facts and the most accurate calculations; the other on the careful disposition of the iron of the pole pieces to receive a maximum of magnetization from a minimum of current.

Electrically Equipped Parlor Car.

The accompanying illustrations show the electrical arrangements of a handsome parlor car recently supplied by the Barney & Smith Car Company, of Dayton, Ohio, to the Erie Railroad for its Tuxedo service. In addition to an unusually complete installation of lamps, the circuits are so arranged that the illumination can be graduated over a very considerable range, and the car is supplied with electric fans and a ladies' hair-curling outfit.

The car is wired throughout with No. 12 wire for 1 per cent. loss at 25 volts. The dynamo and battery wiring to the switchboard is of No. 1 cable run through heavy canvas hose and strapped to the bottom of the car. From the switchboard a double-circuit, two-wire system is used, by means of which each side from the center line of the car is supplied with a complete system. There are 15 circuits, all told, as follows: Eight to the center fixtures, four on the two

FIG. I.—VIEW OF INTERIOR OF CAR.

deck sills, two for the three fans and one for the curling-iron heater at a ladies' dresser.

One side of each circuit unites in a common return or negative main at the switchboard. The other, or positive sides of the lighting circuits, are connected single-pole in pairs through double-pole Bryant switches and double-pole plug cut-outs, thereby keeping the circuits separated, and at the same time enabling the two sides (right and left) of the car to be operated simultaneously.

The fans and curling-iron heater are on independent circuits. Each fan has in the wall near it a Hart flush electrolier switch which is so connected with the fan resistance as to enable three speeds of the fan to be obtained. By the above system of wiring it is possible to get in the main part of the car on the four auxiliary or day circuits any number of lights from one to ten, and by bringing into service

the other eight circuits almost any number of lights from one to forty-six may be put in service.

The main switchboard connections are on the front and made up

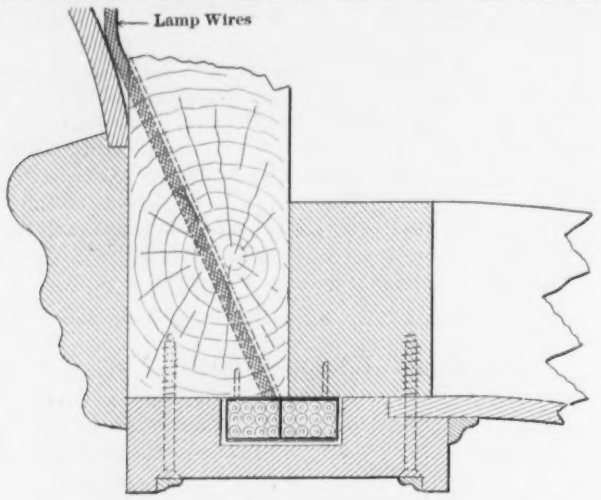


FIG. 2.—DIAGRAM OF WIRE CLEAT.

of bar copper, formed in shape and taped, and then several taped together; thus in case of disconnecting each section will remain intact. The wires are run in metallic cleats and taping in grooves in

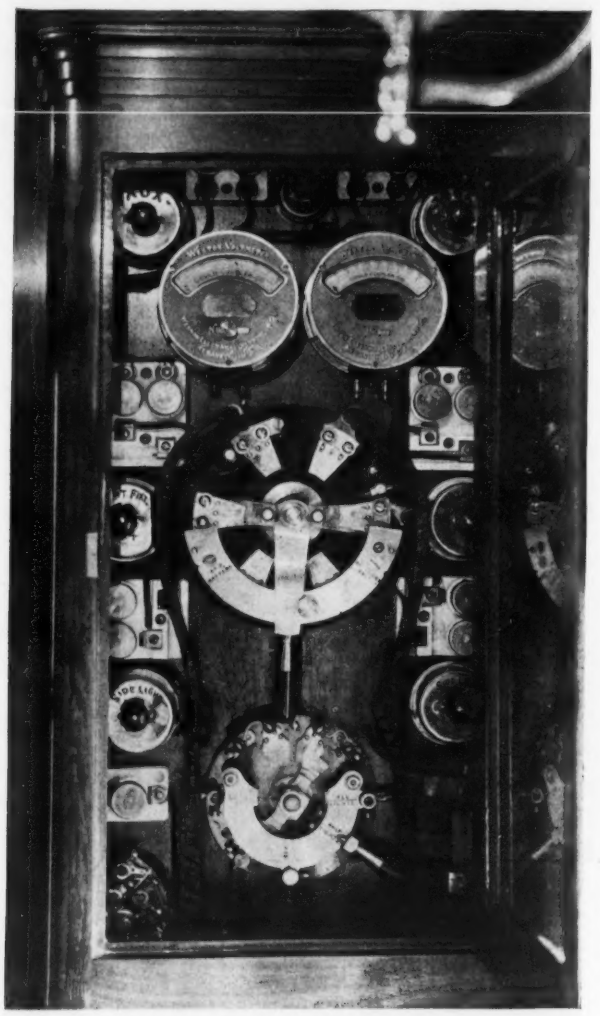


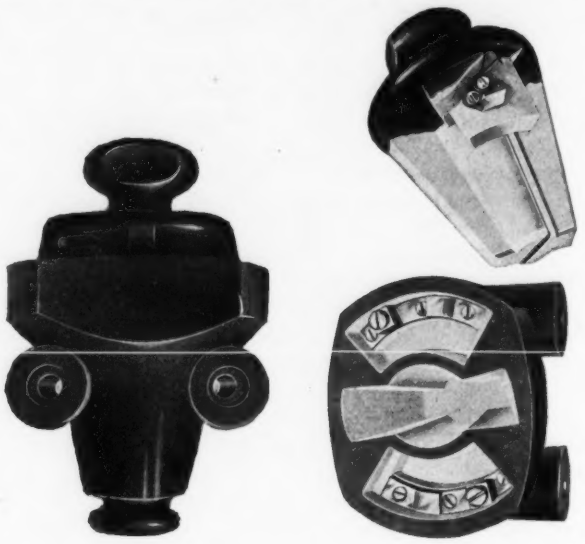
FIG. 3.—SWITCHBOARD ON CAR.

the soft mould, which is screwed to the deck sill, as shown in Fig. 2. All leads in branching therefrom pass up through a mullion over the deck openings to the center fixtures. Six hundred feet of No. 1 cable with over 3,000 ft. of branch and lamp conductor make up the wiring, and 68 8-cp, 25-volt clear, spherical globe lamps are installed. Three 12-in. Diehl fans and one curling-iron heater complete the electrical equipment. The generating and storage battery equipment is of the Gould type. Mr. D. D. Tate designed and installed the switchboard and circuits.

Transformer Primary Cut-Out.

An improved form of a transformer primary cut-out designed to protect the high-tension side of transformers is being introduced by the Westinghouse Electric & Manufacturing Company. It is made entirely of porcelain, and its form is such that it has high insulating and arc-breaking qualities. The plug to which the fuse is attached projects between the terminals, the upper end of it rising well into the top of the block and interposing an effective barrier, and thus making it impossible to maintain an arc. The fuse is eleven inches in length, making a long break, and is so placed that the vapors of a discharge are blown down and out of the device and away from the terminals.

The line wire is carried directly to the top of the device and attached to it as to an ordinary insulator, which it thus displaces. To reach the terminal the wire must be bent around the edge of the block and is so supported in an angle between the terminal post and



FIGS. 1 AND 2.—TRANSFORMER PRIMARY CUT-OUT.

the porcelain case that it cannot be loosened by any swaying of the wire in the wind.

The plug enters from the bottom. When it is raised into place a partial turn draws the knife blades on the plug into the jaws on the block, preventing the plug from dropping out or being blown out.

All live parts are protected from the weather by the projecting edges of the block, and by placing the terminals well above its lower surface, with no apertures in the side or top. A bend in the fuse wire brings it into plain view at all times, and it is thus possible to observe its condition without removing the plug, guarding against any liability of opening the circuit when there is a current upon the line.

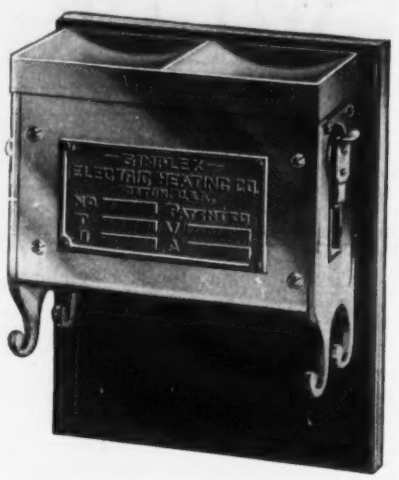
It is fastened to the cross arm or other support by two screws, passing through porcelain tubes which form a portion of the block. It has a rated capacity of 2,500 volts, 30 amp., and is small, light, easy to install and to re-fuse.

Electric Heat in Theatres.

The effort to reduce theatre hazards to the minimum on the part of owners, managers and insurance companies has made a demand for electric curling iron and grease paint heaters so as to enable gas to be eliminated from stage dressing-rooms. In addition to its previous product in this line, the Simplex Electric Heating Company has recently brought out a new type of combined grease paint and curling iron heater. While it is a combination device, the heating of the grease paint is independently controlled.

The grease paint heater is divided in two sections and forms the top of the device and is controlled by a quick opening switch on the left side of the device. The curling iron is inserted at the right side and the current is automatically turned on or off by the action of putting in and removing the curling iron. Hooks are provided for hanging the curling iron when out of use. The device is polished nickel finish, mounted on enamel slate and arranged to fasten to

standard outlet box or on wall as ordered. This product is the result of the co-operation of an expert theatre electrician, George A. Mc-



STAGE DRESSING-ROOM ELECTRIC HEATER.

Curdy, of New York, and the company's engineers, and has been installed in several new theatres.

The company's combination curling iron and grease paint heater, known as No. 1280, is in extended use, and the two types are calculated to meet all requirements.

High-Voltage Oil Fuse.

OIL FUSE.

The accompanying illustration shows a high-voltage oil fuse made by the Anyun Lamp & Electric Company, of Buffalo, N. Y. The fuse is connected to brass rods as shown, and brass terminals are screwed to the latter at the end caps. At the top are air tubes, which also serve for the introduction of the oil.

The glass tube is partly filled with a high grade of transformer oil, which is poured in through one of the air pipes, just enough oil being used to completely submerge the fuse wire. When a short-circuit occurs, the oil enters the space between the two ends of the broken fuse wire, and effectually smothers any arc. The oil becomes darkened after a short-circuit, the discoloration being caused by gases, but resumes its natural color after standing some time. Rubber discs and washers allow expansion and contraction of the glass, and prevent the oil from leaking out. The air space between the surface of the oil and the upper cap allows the oil to rise in the case of a very severe short-circuit, and reduces the amount of pressure against the glass, which is very thick and tough, the air pipes allowing the gases to escape. The fuse is self-indicating, the fuse wire being visible until a short-circuit occurs, which, as stated above, is manifested by the discoloration of the oil. A fuse can be refilled at the power house as often as it blows out, thus practically eliminating any further expense after the fuse has once been installed.

Electricity in a Modern Hospital.

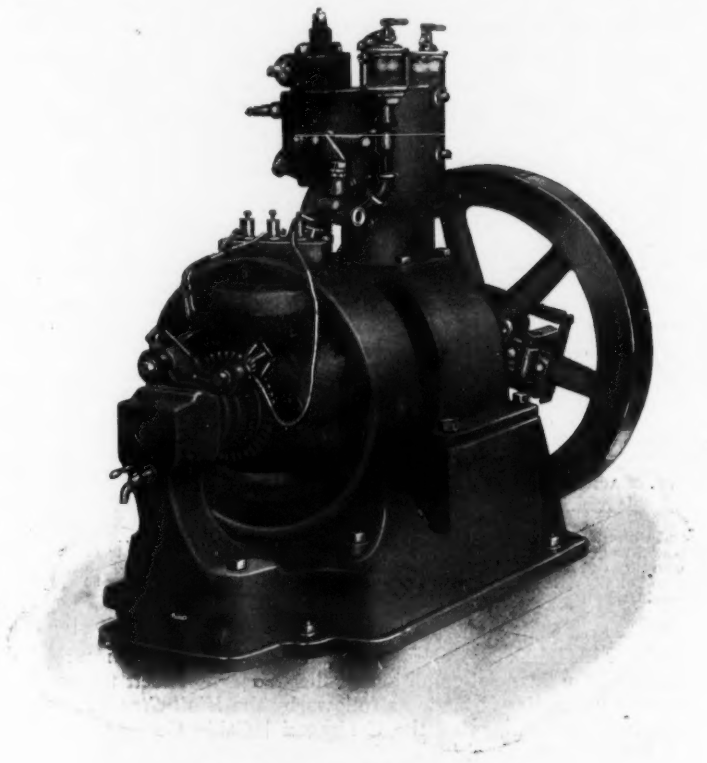
One of the largest hospitals in the country has just been opened in New York City, namely, the Mount Sinai, occupying an entire square block, between Madison and Fourth Avenues and One Hundred and One Hundred and First Streets. There are ten buildings within this space and provision has been made for 456 beds. The equipment is of the most modern and up-to-date character possible.

The electrical service includes 6,000 lamps and 200 hp in motors. There are five General Electric direct-current generators directly connected to five Ball & Wood engines. Three of the units are of 100 kw each and two of 50 kw each. The marble switchboard in the dynamo room is 28 ft. long, 8 ft. high, with bronzed frame and with a grille. A very interesting feature is the use in all the rooms in the private hospital and in all the wards of the Sayles regulators for turning the electric lights up and down. This feature of convenience is very highly appreciated and is now becoming quite common in hospital work. The laundry is operated entirely by electric power and heat, all the ironing being done with electrical irons. There is also a complete interior telephone system of 125 stations and an intercommunicating system of 50 stations. All the clocks, 88 in number, are operated electrically, and there is a storage battery equipment operating telephones, clocks, watchman's detectors, bells, etc., a motor-generator being installed for use in the day time and the battery being a reserve in case of break-down. Everything is in duplicate. There are all told about 100 miles of wire in the building for various purposes. The Charles L. Eidlitz Company was the contractors for all of the electrical equipment.

Lighting Set for Small Yachts.

The compact electric generating set illustrated below has been designed for use on gasoline launches, yachts and sailing vessels, where there is no means of driving a steam engine. The engine of this generating set is a gasoline engine of 2½ hp. The dynamo is of 1-kw capacity and furnishes 10 amp. at 110 volts. The speed of the dynamo is 750 r.p.m. Flexible couplings, etc., are avoided and the armature is mounted on a sleeve which slips over the crank shaft and is held securely in place by means of a long key.

In order to make the set complete, the circulating pump is attached directly to the engine and is driven by means of an eccentric from the cam shaft. The governor is contained in the fly-wheel and is of such sensitiveness that the speed is maintained within 2 per cent. from no load to full load. As weight is to be considered on shipboard all parts are made as light as possible consistent with strength.



GENERATING SET FOR YACHTS.

The dynamo frame is a steel casting of highest permeability. Bedplate and engine frame are made light, but strong enough for the purpose.

The weight of the complete plant is 475 pounds, including fly-wheel and all accessories. The floor space occupied is 20 in. by 34 in. and height is 30 in. The space occupied is so small that this little plant can be placed in an out-of-the-way corner where it will do its work faithfully and conscientiously with not much more noise than a sewing machine. It will furnish sufficient current for lighting 20 incandescent lamps of 16 cp. or a 1,500-cp searchlight and eight or ten incandescent lamps. The manufacturer is the Carlisle & Finch Company, of Cincinnati, Ohio.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was marked improvement in prices of stocks and general activity in speculation, largely on short covering following the announcement of the adverse decision in the Northern Securities case. The market, although professional, was more cheerful in tone at the ending of the suspense, and the favorable crop reports and reported better demand for iron were factors in the improvement. London showed an increaseed disposition to bull American stocks. The Steel shares were the strong features on the better trade outlook, though the general list is higher throughout. The money market continued easy, although there was a slightly increased inquiry for time loans. Metropolitan Street Railway attracted much attention by reason of a break to 104¾ on unfavorable rumors regarding the local traction situation, but it afterwards rallied and closed at 111¾, being a net gain on the week's trading of 4⅞ points. The sales aggregated 65,200 shares. Brooklyn Rapid Transit, after receding to 39⅛, closed at 43⅞, which was the highest quotation of the week, and a net gain of 4⅜. All of the electric securities were also favorably affected by the better feeling in the market. General Electric was quite active, 3,000 shares having been sold. The range of prices was between 160, the lowest, and 167, the highest, the closing figure being 166—a net gain of 6½ points. Westinghouse also made a gain of 6 points, closing at 163, the number of shares changing hands being 5,100. Western Union remained practically steady as to prices, closing at 89⅜, thus netting ⅞-point increase. There was little done in the outside market. Fluctuations were irregular, Interborough Rapid Transit and Electric Boat being firm. Following are the closing quotations of March 22:

NEW YORK.

	Mar. 15	Mar. 22		Mar. 15	Mar. 22
Allis-Chalmers Co.	..	6⅛	Electric Vehicle	7⅛	7
Allis-Chalmers Co. pfd	..	39¾	Electric Vehicle pfd.	10	10
American Tel. & Cable	84	84	General Electric	102¼	168
American Tel. & Tel	121	124	Hudson River Tel.	..	..
American Dist. Tel	22	22	Metropolitan St. Ry.	107⅛	112⅛
Brooklyn Rapid Transit	41¾	43	N. Y. & N. J. Tel.	..	..
Commercial Cable	180	176	Marconi Tel.	..	..
Electric Boat	22	20	Western Union Tel.	88½	88
Electric Boat pfd.	52	50	Westinghouse com.	159	163
Electric Lead Reduction	⅜	¾	Westinghouse pfd.	175	175

BOSTON.

	Mar. 15	Mar. 22		Mar. 15	Mar. 22
American Tel. & Tel	122	124	Western Tel. & Tel. pfd.	78	75
Cumberland Telephone	115	*115	Mexican Telephone	1⅛	1¼
Edison Elec. Illum.	234	233	New England Telephone	118	117
General Electric	162	168	Mass. Elec. Ry.	18	19
Western Tel. & Tel	8⅝	8⅛	Mass. Elec. Ry. pfd.	71½	72

PHILADELPHIA.

	Mar. 15	Mar. 22		Mar. 15	Mar. 22
American Railways	42⅛	43	Phila. Traction	..	95½
Elec. Storage Battery	52	57	Phila. Electric	5⅞	6
Elec. Storage Battery pfd.	52	57	Phila. Rapid Trans.	13⅛	14
Elec. Co. of America	7⅞	8			

CHICAGO.

	Mar. 15	Mar. 22		Mar. 15	Mar. 22
Central Union Tel.	..	..	National Carbon pfd.	97½	99⅞
Chicago Edison	..	150	Metropolitan Elev. com.	14	16¼
Chicago City Ry	156	155	Union Traction	5	5
Chicago Tel. Co	..	..	Union Traction pfd.	30	30
National Carbon	25	28			

*Asked

THE MACKAY-BENNETT PROPERTIES.—An interesting analysis of the financial condition of the Mackay-Bennett telegraphic and cable properties is made as follows by the *Wall Street Journal:* "Applying the earnings of the Commercial Cable Company for the year 1903 to the securities of the proposed Mackay companies, the $1,708,526 surplus after charges equals 4 per cent. on the $30,000,000 cumulative preferred stock, and 1.6 per cent. on the $30,000,000 common. The stock of the Mackay companies, if the plan is successful, will be exchanged for the $15,000,000 stock of the Commercial Cable Company now outstanding at the rate of two shares of new preferred and two shares of new common for one share of Commercial Cable. As the latter is now paying 8 per cent. dividends, the full 4 per cent. required on the new preferred stock could be paid without increasing the present dividend requirements. The new common stock would represent the present individual earnings of Commercial Cable. It is possible that a larger earning capacity might be figured for the new common stock. In addition to the $500,000 reserve charged off from the surplus after dividends, Commercial Cable charged another reserve sum to operating expenses, under the item "land line repairs and reserve for reconstruction and extensions." This item last year amounted to $2,025,383, compared with $1,806,015 the previous year. The great growth in the business of the Commercial Cable Company in the last few years suggests possibilities for the common stock of the proposed company. In the last six years gross earnings have increased 65 per cent.

UNITED STATES TELEPHONE.—The financial report of the United States Telephone Company, of Cleveland, Ohio, made last week was exceedingly gratifying to the stockholders. One year ago the company had a deficit of $21,138, but the report last week shows the deficit entirely wiped out and a net balance of $15,972 on hand at the end of business for 1903. Plainly speaking, the company made $37,706.17 for the year 1903, instead of losing $21,138.32, as it did in 1902, and President Dickson says the profits for 1904 will be very much larger. It was the best report the stockholders had ever received from the company and the meeting had the flavor of a love feast. The company's balance sheet is as follows:

ASSETS.

	1903.	1902.
Property and plant	$4,054,887.30	$3,925,016.04
Material and supplies	30,651.93	53,073.47
Treasury stock	390,000.00	.....
Treasury bonds	105,000.00	.....
Current assets	99,926.83	86,202.27
Deferred assets	4,582.16	1,133.85
Total assets	$4,685,048.22	$4,065,425.73

LIABILITIES.

Capital stock, common	$2,000,000.00	$2,000,000.00
Capital stock, preferred	500,000.00	.....
Mortgage bonds	1,970,000.00	1,865,000.00
Current liabilities	187,817.16	215,201.00
Deferred liabilities	11,258.88	6,363.05
Total liabilities	$4,669,076.04	$4,086,564.05
Surplus	15,972.18	21,138.32
Total liabilities	$4,685,048.22	$4,065,425.73

The company's gross earnings for the year were $379,235.10, a gain of $76,838.85 over preceding year. Its net increase was $140,275.69, a gain of $17,165.48. The surplus was $37,706.17, a gain of $14,470.52. Deducting the $21,733.99 deficit, leaves a surplus of $15,972.18. The directors elected are H. A. Everett, F. S. Dickson, E. W. Moore, J. R. Sprankle, J. B. Hoge, J. W. Marsh, C. W. Wason, J. B. Hanna, R. Mahler. The officers are: F. S. Dickson, president; E. W Moore, vice-president; James B. Hoge, secretary; R. W. Judd, treasurer.

DIVIDENDS.—The American Telegraph & Telephone Company has declared the regular quarterly dividend of 1½ per cent. The dividend is payable April 15. Detroit United Railway directors have declared the regular quarterly dividend of 1 per cent., payable May 2. The Union Switch & Signal directors have declared the regular quarterly dividends of 2½ per cent. on the preferred and 2 per cent. on the common, payable April 10. United Gas Improvement, Philadelphia, has declared the regular quarterly dividend of 2 per cent., payable April 15. Bell Telephone, of Philadelphia, directors have declared a regular quarterly dividend of 1½ per cent., payable April 15. The General Electric Company has declared a dividend of 2 per cent. payable April 15, on the common stock. The Metropolitan Street Railway Company, New York City, has declared a regular quarterly dividend of 1¾ per cent. on the capital stock, payable April 15.

NEW BULLOCK COMPANY.—The incorporation papers of the Bullock Electric Manufacturing Company, of Norwood, Ohio, have been filed at Columbus, Ohio. The new company is incorporated with a capital stock of $500,000, the incorporators being Richard P. Ernst, Alfred C. Cassatt, Frank F. Cattle, James C. Marshall and John E. Shepard. It will be the leasing company of the present Bullock Company, which is now, through this leasing company, controlled by the Allis-Chalmers Company. The president of the new company is George Bullock and the vice-president Joseph S. Neave. Other details of this contemplated action were given in our issue of March 12.

CONNECTICUT MORTGAGE.—The Connecticut Railway & Lighting Company has filed a mortgage for $1,000,000 in favor of the Central Trust Company, of New York, to secure an equal amount of bonds.

NEW YORK-PHILADELPHIA TROLLEY.—The Middlesex & Somerset Traction Company, which has fifty miles of track in Middlesex and Somerset Counties, New Jersey, has been sold to the Public Service Corporation of New Jersey for $2,250,000. The Middlesex & Somerset Traction was owned by ex-Judge Gotfried Kreuger, of Newark; Andrew Radel, of Bridgeport, the heirs of the late John Radel and Edward H. Radel. The buying of the local trolley system completes the Public Service's through line from New York to Philadelphia. The corporation added very recently to its through line by purchasing the line from Camden to Trenton, and is now building a road from the terminus of the Camden road at Trenton to connect with the end of the Trenton fast line at the fair grounds. The Public Service closed the deal a short time ago for the right of way over the Trenton fast line, and, it is understood, will take over this road probably within the next thirty days.

FIGURES OF FRANCHISE TRUSTS.—In his recent work on the trusts, Mr. John Moody shows that there are 318 important industrial trusts in this country, controlling 5,288 plants, and having a total capitalization outstanding of $7,246,342,533. The eight leading franchise trusts are the American Bell Telephone, the Western Union Telegraph Company, the Commercial Cable Company, the Federal Telephone Company, the Consolidated Telephone Company, the International Telephone Company, the Interstate Telephone Company and the United Telephone & Telegraph Company. These control 136 plants and have a total capitalization of $629,700,500. There are also 103 leading gas, electric light and street railway consolidations, making a total of 111 important franchise trusts, controlling 1,336 plants, and having a total outstanding capitalization of $3,735,456,075.

Commercial Intelligence.

THE WEEK IN TRADE.—Reports from distributive centers still complain more or less of the backwardness of spring trade, which is generally attributed to the bad weather, yet there have been several favorable developments. Chief among these is the arrival of much-needed moisture in the southwestern wheat belt; the continued improvement in the iron and steel trade, and the decision of the bituminous coal miners not to strike against the proposed reduction of wages. The railway situation shows improvement, in that February made a slightly better comparison than January, an increase in gross receipts being indicated for the former month. Money continues easy, but collections are still classed as unsatisfactory at several points. The agricultural situation, though marred by the irregular condition in winter wheat, is on the whole very promising. An immense acreage will undoubtedly be planted in cotton in the South. In cotton liquidation has been a feature, induced by poor trade reports and slightly heavier receipts, the suspension of a large speculator resulting on Friday. A net loss of over 1½ cents per pound is shown on the week. In iron and steel large buying by leading interests has induced free purchasing by smaller concerns, hence advances are noted of 25 to 50 cents per ton on all grades of pig iron. Agricultural implement manufacturers are doing the best business in years. *Bradstreet's* reports 193 business failures during the week ending March 17, against 200 the week previous and 194 the corresponding week last year.

GOULDS PUMP CONTRACTS.—The Goulds Manufacturing Company, of Seneca Falls, N. Y., reports the following large recent contracts: Baltimore and Ohio Railroad Company, for its plant at Glenwood, Pa., three 13-inch x 12-inch Triplex power pumps with Westinghouse motors; Proctor & Gamble Co., Kansas City, Mo., 22 power pumps of various sizes for its new plant; E. J. DuPont Co., Penns Grove, N. J., 6 power pumps for the general water supply and distribution system; Indestructible Fibre Company, for Massena, N. Y., one 14-inch x 12-inch power pump, and one other of smaller size; Hurtig & Seamon's Music Hall, New York, a 500-gallon fire pump; Princess Theatre, New York, a 500-gallon fire pump; American Machinery and Export Company, one double-acting 14-inch x 16-inch Triplex power pump, for the water works at Vera Cruz; Brooklyn *Daily Eagle*, Brooklyn, N. Y., a 500-gallon fire pump, one Triplex deep open well pump, and also one house pump; Muller, MacLean & Co., New York, one Triplex power pump for water works plant, at Manila, P. I.; George A. Fuller Co., for the New York *Times* Building, New York, all Triplex power pumps on the specifications, with Crocker-Wheeler motors.

CUBAN LIGHTING AND TRACTION EQUIPMENT.—Contracts will be let very shortly for the construction and equipment of a large water power plant in Cuba, intended to develop current for lighting and traction in Cienfuegos and the towns of Caonao, Palmira, Harmiguera and Cruces, and for operating large sugar mills in the vicinity. The Cienfuegos, Palmira & Cruces Railroad & Electric Power Company will undertake the work. Mr. Bruno Diaz, a large Cuban cigar manufacturer, is president of the company. Mr. Cornelius C. Vermeule, 203 Broadway, is consulting engineer. The plant will be built at the Falls of Hababinalla, located about 30 miles from Cienfuegos. The available head is 480 ft. The initial capacity of the plant will be 6,000 hp. Four units of 1,500 hp will be put in. There will be about 40 miles of electric traction system constructed. About five miles of line will be built in Cienfuegos, which is without tramways of any description. The track will be standard gauge and 4,400 tons of T rails (70 pounds) will be ordered, with 4,100 trolley poles. Construction will be begun early in April and the entire system is expected to be in active operation inside of twelve months.

A 35,000-H.P. MEXICAN WATERPOWER PROJECT.—The construction of a hydraulic plant whose capacity is expected to be about 35,000 h.p. is contemplated in the State of Puebla by Mexican capitalists, who propose to supply light and power to various towns and industrial establishments in that part of the world. The necessary concession has been obtained from the Mexican Government authorities. The Falls of Flatlahuqui, on the Apulco River, will be utilized for furnishing the energy. These falls are reputed to be about 400 feet in height. Luis Fernandez Castillo, of Mexico City, is the concessionaire.

MEXICAN SUGAR FACTORY.—The Mexican Tropical Planters' Company, in which Boston and Kansas City capitalists are primarily interested, is about to let contracts for the construction of a large sugar factory on its 50,000-acre property known as the Columbia plantation, on the Coatzacoalcos River, Isthmus of Tehuantepec. It has not been fully determined yet whether or not the plant will be electrically operated. A large lighting equipment will, however, be installed. Mr. Louis Kunz is general manager at the plantation.

BULLOCK ORDERS.—The Bullock Electric Manufacturing Company of Cincinnati, Ohio, has just received an order from the Denver Gas and Electric Company, Denver, Colo., for one 1,500 kw 2,400 volt, 3-phase, 100 r.p.m., 60 cycle, fly wheel type generator. This machine is a duplicate of one they installed for this company about a year ago. The Denver Gas and Electric Company has also installed four 600 kw 3-phase, 2,400-volt alternators which makes a total of 6,000 kw in Bullock alternators installed.

THE AUTOMATIC ELECTRIC COMPANY announces that the Citizens' Telephone Company, of Columbus, Ohio, has increased the order placed with it some time ago. The original order called for complete Automatic equipment for 7,000 stations initial installation. The new order makes the number of stations to be installed in the beginning, 8,000. The Citizens' Company will build a new house for the Automatic Exchange, which will be designed specially for this type of equipment.

THE INDIANA RUBBER AND INSULATED WIRE COMPANY, Marion, Ind., has just finished sending out four orders to foreign countries. The first order was for 200,000 ft. of telephone wire or cable, which was shipped to Yokohama, Japan; the second for one ton of rubber tape, shipped to Alexandria, Egypt; the third one ton of tape to Berlin, Germany, and the fourth one ton of tape to Paris, France. Other foreign orders have been received and will be shipped soon.

BELL TELEPHONE OUTPUT.—The American Telephone & Telegraph makes the following instrument statement for the month ended February 29:

	1903.	1902.	1901.
Gross output	84,402	91,844	95,584
Returned	37,093	35,188	36,855
Net output	47,309	56,656	58,729
Total outstanding	3,880,616	3,296,527	2,637,355

BALL ENGINE CONTRACT.—On March 11 the Ball Engine Company, of Erie, Pa., made a shipment, composed of four cars, carrying a large 20 x 38 x 30 horizontal cross-compound side-crank engine, of their Corliss type, direct-connected to 400-kw alternator; alternator and wheels placed between the frames. This shipment went to the National Tube Company, Pittsburg, Pa.

EQUIPMENT WANTED IN ARGENTINA.—A large preserved meat factory is about to be built in the Argentine Republic, which will be lighted and largely operated by electricity. Alberto de Permentier, of Buenos Ayres, will be in charge of the construction. Interested parties writing him would do well if they used either the French or Spanish language.

STREET CAR CONSOLIDATION.—The J. G. Brill Company, the great street car builder, of Philadelphia, has secured control of the G. C. Kuhlman Street Car Manufacturing Company, of Cleveland, and will reorganize it.

THE EASTMAN KODAK COMPANY, of Rochester, N. Y., the well-known manufacturer of cameras, has purchased two 16 x 28 x 18 vertical cross compound engines of the Ball Engine Company, Erie, Pa.

General News.

THE TELEPHONE.

DENVER, COL.—The Wray Telephone Company has secured franchises in the eastern portion of the state for the extension of its system.

WASHINGTON, D. C.—The Kurtz International Telephone Company has been incorporated with a capital stock of $10,000,000. The incorporators are: J. W. Kurtz, J. A. Thompson, Harvey T. Winfield, Joseph A. Rath and Charles Fitts.

ALBION, ILL.—The Edwards County Mutual Telephone Company has been incorporated with a capital stock of $8000. Directors: W. J. Reid, T. B. Mitchell and others.

SALEM, ILL.—The Maron County Co-operative Telephone Company has been incorporated with a capital stock of $1000. The directors are: J. Herchberger, W. J. Martin and others.

HERMON, ILL.—The Hermon & St. Augustine Telephone Company has been incorporated with a capital stock of $1000. The directors are: W. A. Bogan, G. M. Brown and others.

DANVILLE, IND.—The Farmers' Co-operative Telephone Company has filed articles of incorporation. John F. Hardwick is president, and A. C. Underwood, secretary.

SOUTH BEND, IND.—The South Bend Home Telephone Company has purchased the property of the Electric Investment Company, of Mishawaka, paying therefor $14,000.

DANA, IND.—The Citizens' Mutual Telephone Company has incorporated. The capital stock is $6000. De Witt C. Keruse, Harry Bales and S. E. Scott are the incorporators.

TERHUNE, IND.—The Terhune Co-operative Telephone Company has filed articles of incorporation. Capital stock, $2000. Louis A. King, Albert Robison and Simon Cox are the directors.

ELBERFELD, IND.—The Elberfeld & Millersburg Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock is $4500. Dr. L. Brown, Fred Kampe and Henry Menke are the directors.

SELMA, IND.—The members of the Selma Co-operative Telephone Company held a meeting last week and decided to purchase an exchange building and install a new switchboard, and otherwise improve and extend the plant.

TANGLEWOOD, IND.—The Tanglewood Telephone Association will construct a line to the corporation line of Versailles, where it will connect with the Spencer telephone system. This line will start with a large number of subscribers. Chas. Braley is president, and J. E. Waters, secretary.

WARREN, IND.—The Warren Home Telephone Company's plant has been sold to the Warren Telephone Company, recently incorporated with a capital stock of $25,000 for the purpose of taking over the old company's property. The plant will be improved and the lines extended throughout Huntington and Grant counties. W. Griffith heads the new company.

JONESBORO, IND.—A war has been declared on the Bell Telephone Company by the merchants of this city. Two companies have franchises to operate —the Bell and the Independent. The merchants grew tired of the dual systems, and adopted the Independent. The Bell Company's telephones have all been ordered out of places of business and a rule passed that any merchant in the future who uses a Bell telephone in his business or at home will be expelled from the association. The Bell Company now proposes to enter the mercantile business by establishing a large department store and low prices in Jonesboro.

INDIANAPOLIS, IND.—At a meeting of the stockholders of the New Telephone Company, on March 10, the following directors were elected: L. C. Walker, B. E. Parrott, J. W. Bowles, F. L. Holweg and I. D. Wiest. L. C. Walker was elected president to succeed S. P. Sheerin, who retired to become president of the Indianapolis Telephone Company. The lease of the properties of the New Telephone Company to the Indianapolis Telephone Company was authorized. The rapid growth of the business of the New Telephone Company made it necessary to raise additional capital in order to meet all the demands made for service. The report made to the stockholders showed that the gross earnings of the New Telephone Company during the year ending with February were $227,196, an increase over the previous year, after deducting operating expenses, depreciation, fixed charges and dividends, amounting to $177,410. The company now has a total surplus of $130,223. By the extensions to be made to the property by the Indianapolis Telephone Company, the earning capacity of the company will be increased nearly $250,000 a year, or nearly 20 per cent. gross on the $1,200,000 capitalization.

DURANT, I. T.—The Chickasaw Choctaw Telephone Company will erect an exchange here and extend its line to Bennington.

RICE, KAN.—The Hillsdale Telephone Company has been incorporated with a capital stock of $2500.

CLARENCE, MO.—A new telephone company is being organized here by farmers, to be known as the Independent Telephone Company. Frank Dorrell was elected president.

RALEIGH, N. C.—The Raleigh Telephone Company recently re-elected the present board of directors. The rumor of the sale of the company is stoutly denied. There are three companies in Raleigh.

ASHEVILLE, N. C.—At Asheville recently a number of citizens signed an agreement to use only the service of the Asheville Telephone Company, now sold out, and the question has arisen as to who is responsible for the low rates. The attorney of the new merger holds that the stockholders of the old company are responsible.

GREENSBORO, N. C.—An interesting fight is now on here over the attempt of the Southern Bell Telephone Company to raise its rates to "standard" rates, which the company claims is allowed it by the state corporation commission.

PAINESVILLE, OHIO.—A new telephone company has been organized here to install an exchange at Le Roy. W. M. Baker was elected president.

NORTH BENTON, OHIO.—The North Benton-Deersfield Telephone Company has increased its capital stock from $1000 to $15,000.

BRYAN, OHIO.—The Bryan Telephone Company has increased its capital stock from $40,000 to $75,000. W. W. Morrison is president.

LAKE, OHIO.—The Tri-County Telephone Company has been incorporated with a capital stock of $10,000. The directors are: N. B. Biddleman, M. M. Bauer and others.

NEWARK, OHIO.—The Newark Independent Telephone Company has now over 1400 connections. It has recently installed 70 new telephones and has orders for 25 more.

CALDWELL, OHIO.—The Farmers' Telephone Exchange Company has been incorporated with a capital stock of $10,000. The directors are: J. M. Harding, L. W. Wheeler and others.

FORT SUPPLY, OKLA.—The Fort Supply Telephone Company has been incorporated to construct a telephone from Beaver City to Gaery.

HARRISON, OKLA.—The Gotebo Telephone Company has been incorporated with a capital stock of $10,000. The directors are: H. Dalke, W. H. Kuda and others.

WILKESBARRE, PA.—A new telephone company is being organized here, with C. H. Randall as president.

PITTSBURG, PA.—The Pittsburg & Allegheny Telephone Company will extend its system to the south and west.

COLUMBIA, S. C.—The new telephone law in South Carolina, just passed by the state legislature, places all telephone companies under the supervision of the corporation commission. On account of alleged conflicting clauses, it is said that the bill will scarcely be effective. The commission has already applied to the attorney-general for an interpretation of the measure.

VOLGA, S. D.—The Dakota Central Telephone Company will extend its lines to Wentworth.

BROOKINGS, S. D.—The Thompson, Caldwell & Wilson Rural Telephone Company has been formed here. Materials have been ordered for the building of 60 miles of line.

DEADWOOD, S. D.—The Harrison Telephone Company has been succeeded in eastern South Dakota by the Home Telephone Company, recently organized to take over the system and business.

KNOXVILLE, TENN.—The People's Telephone & Telegraph Company has asked for a right to lay about one mile of underground conduit.

RIVES, TENN.—A new telephone company has been organized here by T. J. Bonner, B. J. Wade and others.

HUNTINGDON, TENN.—The Western Dixie Telephone Company has been organized at Vale, this county, with E. B. Simmons, president; Dr. Florence, vice-president, and A. N. Presson, secretary and treasurer. The company has lines in operation between Camden and Huntingdon and several subscribers at both places. It is the intention of the company to extend its service.

SAN ANTONIO, TEX.—The Southwestern Telegraph & Telephone Company will expend about $80,000 in extending and improving its system in this city.

NEW BRAUNFELS, TEX.—The Independent Commercial Telephone Company has applied to the City Council of New Braunfels for a franchise to install a telephone exchange here.

SAN ANTONIO, TEX.—Frank C. Smith, of San Antonio, president of the Commercial Telephone Company, announces that he has just purchased for his company the independent telephone exchanges at Austin, Taylor, Temple and Belton, and that he has leased from the Beaumont Northwestern Telephone Company the long distance lines and local exchanges belonging to that corporation. Mr. Smith denies the published report that he was acting for H. E. Huntington, of California, in making these purchases. He says that extensive improvements will be made to the acquired properties.

SALT LAKE CITY, UTAH.—It is stated by the management of the Independent Telephone Company that by May 1 its system will be in operation in Salt Lake and Ogden and that by that time the company will have expended $1,000,000 on construction work. Buildings in both cities are now almost ready for occupancy. A switchboard which will accommodate 12,000 connections is being installed here. The plans of the company include the invasion of Idaho and Montana within the next year.

LYNCHBURG, VA.—The Southern Bell Telephone Company has applied for a new franchise at Lynchburg, and a warm fight is expected. A minority report of the Council committees has been made asking for lower rates.

LENA, WIS.—A telephone company with a capital stock of $4000 has been organized here. It was promoted by A. W. Larson, of Wausaukee, and it will be known as the Farmers' & Merchants' Telephone Company.

MONROE, WIS.—Prominent farmers of Adams and Washington townships are organizing a telephone company for the purpose of building a line out through the towns. E. Holcomb, F. Hefty and others are interested.

VERA CRUZ, MEX.—The Government of the State of Vera Cruz has granted a concession to A. Espinosa, of Vera Cruz, for the establishment of a complete telephone system here.

CITY OF MEXICO, MEX.—The Department of Communications and Public Works of the Mexican Government has ordered the construction of an extensive system of telephone lines in the Yaqui district, State of Sonora. It is proposed to connect every town and hamlet in that district with telephone communication. This action is taken in order that the movement of troops in pursuit of Yaqui Indian outlaws may be expedited and also to help in the settlement and development of that rich region. The Secretary of Communications and Public Works, City of Mexico, can give information in regard to the proposed work.

ELECTRIC LIGHT AND POWER.

CLANTON, ALA.—J. P. Van Derveer has a franchise for an electric light and power plant. The details will be ready in a short time.

MENDOCINO, CAL.—The Mendocino Electric Light & Power Company has been formed by A. Brown, of Mendocino, and others, with a capital of $25,000. They have purchased the electric light plant at Mendocino and will furnish light to the coast towns.

SANTA CRUZ, CAL.—The Big Creek Power Company, of Santa Cruz, contemplates erecting an additional generating station at Chittenden from which it can supply light and power to Watsonville, Gilroy and Hollister, if satisfactory terms can be obtained. A steam plant will also probably be constructed.

GLENWOOD SPRINGS, COL.—The Colorado Power & Irrigation Company is making preparations to begin immediate work on a plant at the Shoshone Falls, on the Grand River, near here, as soon as the weather conditions will permit. It is estimated that the plant will have a capacity of about 20,000 horse-power, which will be a sufficient supply for this city, Leadville and a number of adjacent mining towns.

WOODBURY, CONN.—An electric light plant will probably be erected this spring, at a cost of $15,000, by the local company. E. S. Boyd is secretary.

THOMASTON, CONN.—The Thomaston Electric Light Company has decided to construct a new plant in the spring. The plant was destroyed by fire last fall.

SANDPOINT, IDAHO.—The Sandpoint Water & Light Company has been incorporated, with a capital of $50,000, by J. D. Sherwood, Wm. G. Malloy and B. C. Riblet, of Spokane, Wash., and L. D. Farmen, of Sandpoint.

GEORGETOWN, ILL.—W. C. Dukes and Edw. Cooley have secured a franchise for an electric light plant.

HARMON, ILL.—The citizens and the Village Board are considering the advisability of constructing an electric light plant.

QUINCY, ILL.—The City Council has appointed a committee to investigate the feasibility of constructing conduits and placing all wires underground in the business district of the city, contemplating a general system over the entire city, to be owned and controlled by the city, users to lease the same. Address F. C. Hancock, city engineer.

NORTH VERNON, IND.—The Town Council is taking steps to enlarge and improve the electric light plant.

JASPER, IND.—It is reported that the Town Council is preparing to contract for the construction of an electric lighting and power plant.

HOPE, IND.—The Hope Canning Company has incorporated to install an electric plant to light its factory and also to sell light and power to the citizens of the town of Hope.

NEWHAVEN, IND.—Bids will be received April 5 by the Board of Town Trustees for furnishing material and constructing a complete electric light plant. H. H. Schnelker is chairman.

ANDERSON, IND.—The municipal electric light plant of this city has been enlarged to a capacity for a city of 50,000 inhabitants. The commissioners have announced that on April 1 a 30 per cent. reduction will be made in the rates for electric light service. The maximum rate at this time is 10 cents per kilowatt and the minimum is 6 cents.

ELKHART, IND.—The Elkhart Electric Company and the Home Electric Light & Power Company, of this city, have merged and filed amended articles of incorporation with the Secretary of State. The capital stock of the former company is $100,000 and of the latter company $50,000. The name of the merged or united company is the Elkhart Electric Company, and the capital stock is increased to $250,000. The operation of the new company will be carried on in Elkhart and Elkhart County.

CORNING, IA.—A receiver has been appointed for the Corning Electric Company on the application of the Hanover National Bank, of New York, and the First National Bank, of Corning, who are creditors of the company.

UNIONTOWN, KY.—G. F. Cecil, of Springfield, Ky., has purchased the electric light plant, and will make improvements to the same.

BALTIMORE, MD.—It is stated that the Maryland Telephone & Telegraph Company will enter the electric lighting and electric power field. This move will bring it into direct competition with the United Electric Light & Power Company, which has heretofore had a monopoly in this line. The Electrical Commission has granted a permit to the telephone company to enter the subway conduits with wires for furnishing electric lights and power. President Webb, of the telephone company, states that the company has purchased the plant of Mr. J. H. Purnell for immediate use, and that plans are being prepared for a larger plant, to cost about $1,000,000. The United Electric Light & Power Company has protested against the granting of such conduit privileges to the Maryland Company.

GRAND RAPIDS, MICH.—The question of enlarging and improving the electric light plant, at a cost of about $11,000, is under consideration by the Council.

GRAND RAPIDS, MICH.—The Cascade Electric Company, of Grand Rapids, has been organized to construct a power house on Thornapple River and transmit electricity to this city; capital, $15,000. The company proposes to construct a dam at Cascade, which will raise the river 22 feet, and furnish 1000 horse-power. E. C. Follmer is president and E. A. Stowe secretary.

SOUTH STILLWATER, MINN.—B. L. Hanks, Recorder, writes that the citizens have voted to issue bonds for an electric lighting plant.

HELENA, MONT.—The Bow Power Company, which was recently incorporated in South Dakota, is reported to have in contemplation the construction of a dam across the Missouri River below Helena and the generation of electric power to be conveyed to Helena, Butte, Anaconda and other points. About $750,000 will be expended.

SODUS, N. Y.—The Town Board has granted the Sodus Gas & Electric Company a franchise for an electric light plant.

PENN YAN, N. Y.—N. S. Dailey, Village Clerk, writes that it was voted March 15 to issue $35,000 bonds for the construction of an electric light plant.

ROCHESTER, N. Y.—As a result of negotiations between Mayor Cutler and the Rochester Gas & Electric Company, the poles and wires on Monroe Avenue in this city will be removed and the wires run through underground conduits.

NEW YORK, N. Y.—A bill has been introduced in the Assembly at Albany to confer additional powers upon the Board of Aldermen of New York City. One of the most important of these powers is the permission to establish, build or equip telegraph, telephone or other alarm system or systems of communication for the police and fire departments and for the construction of subways and pipe galleries for the purpose of containing wire tubes, conductors, sewer pipes, gas or water pipes, and for other similar purposes. This would affect the Empire Subway Company, which has a monopoly in its line in New York City now.

ASHEVILLE, N. C.—Bids are wanted April 1 for constructing an electric light plant. B. M. Lee is City Engineer.

OXFORD, N. C.—The Town Commissioners have granted Mr. Ebert, of Watertown, Conn., a franchise for water works and an electric light plant.

KINSTON, N. C.—Bids will be received by N. J. Rouse, Mayor, April 18, for constructing water works, a sewerage system and an electric light system.

HICKORY, N. C.—K. C. Menzies has been appointed temporary receiver of the Thornton Light & Power Company, of Hickory. The liabilities include a complete city lighting plant valued at about $25,000.

MINOT, N. D.—It is stated that an extensive addition may be built to the electric light plant this spring.

BEDFORD, OHIO.—The People's Electric Light Company, of this place, has passed into the hands of E. E. Mandeville and Edwards Robert, of Philadelphia, who will make considerable improvement in the machinery and equipment of the plant.

PITTSBURG, PA.—The Allegheny County Light Company has secured the contract for lighting the city for one year at $96 per 2000-cp arc lamp; and $35 for 50-cp incandescents.

COLUMBIA, TENN.—The Board of Aldermen has authorized the street commssion to investigate the question of constructing an electric light plant.

HEMPSTEAD, TEX.—An electric light plant is to be installed here. W. P. Lipscomb can give information.

SALT LAKE CITY, UTAH.—The Council is investigating charges against the Utah Light & Railway Company, which is accused of using inferior meters, unsatisfactory service, and charging the city and citizens for lighting which was not furnished. A similar investigation was made a short time ago by the Commercial Club, but no definite action was taken.

NEWPORT NEWS, VA.—The Consumers' Light, Heat & Power Company, of Newport News, has been placed in the hands of a receiver, J. A. Willett being appointed as such. T. T. Thompson, one of the largest stockholders, applied for the receivership, claiming that the business was not on a paying basis.

RICHLAND CENTER, WIS.—It is reported that the city will construct an electric light plant, at a cost of $20,000.

NEENAH, WIS.—The City Council has granted the Wisconsin Traction, Light, Heat & Power Company a 10-year franchise for lighting the city.

MARSHFIELD, WIS.—The City Council has come to an agreement with the Marshfield Water, Electric Light & Power Company, whereby the city is to buy the electric light and water plant at $150,400.

KEWAUNEE, WIS.—The question of issuing bonds for a new electric light plant and water works will be submitted to the people at the coming spring election. At the same time the question of municipal or private ownership will also be voted upon.

HAVANA, CUBA.—In consequence of the extension of the plans for the construction of the Cienfuegos, Palmira & Cruces Electric Power & Railway Company's system, bids for the work on the modified plans will be readvertised, to be received about June 15.

WHITBY, ONT.—Bids are wanted April 4 for $15,000 electric light and $50,000 water works bonds. Jos. White is Town Treasurer.

TORONTO, ONT.—The Electric Development Company, of Ontario, has made public some of its plans for transmitting power from Niagara Falls to Toronto. As a start, 50,000 horse-power will be transmitted. The company has a private right of way, and, in place of wooden poles to support the wires, galvanized steel towers will be used. These towers will be 400 feet apart and the west cross arm will be 45 feet high. There will be four circuits, so that in case of any accident to one of the circuits, three others will be available. The voltage on the line will be 60,000 volts. There will be a transformer house at Niagara Falls, at which the voltage will be stepped up, and another at Toronto where it will be stepped down to the voltage commercially in use. The works at Niagara are proceeding very rapidly and about 450 feet of the main tunnel has been excavated. The coffer dam is practically completed and the work on the wheel pit is progressing very rapidly. It is expected that the excavation of the pit will be completed about the first part of August next. The transformer houses will also be erected this season.

OTTAWA, ONT.—It is announced that one of the Canadian Pacific Railway Company's interesting changes, now in progress in the west, is the new stage reached in the work on the $500,000 power improvement to the company's facilities at Fort William, Ont. The motive, light and heating power is all to be changed to electricity. The work of installing the machinery in the new power house has just begun, and is proceeding apace. The power house is now complete with the exception of the machinery. The plant, when finished, will be capable of developing 3000 horse-power, which will be distributed over all the operations of the Canadian Pacific at Fort William, including the lighting systems, operation of the elevators, water works and machine shops.

THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company has bought a piece of property near its power house, so as to enlarge the plant. Several new boilers, a 60-cycle, three-phase, 2300-volt alternator and a new direct-current, 1600-kw, 575-volt generator will be installed.

OAKLAND, CAL.—The San Francisco, Oakland & San Jose Railroad Company, operating the Key Route, is preparing to erect new shops and enlarge the power station capacity. Eight-car trains are frequently operated on this line.

DENVER, COL.—General Manager C. W. Sells, of the Manitou & Pike's Peak Cog Road, announces that after this year the road will be operated by electricity. The work of changing the motive power from steam to electricity will cost approximately $200,000.

LOVELAND, COL.—It is said that W. A. Riley, who constructed the Loveland-Estes Park road, has under consideration a plan to build an electric railway on the road. Mr. Riley, it seems, built the road for the county at a cost of $18,000, and it is said that they would grant him a franchise over it for a like amount.

GLENWOOD SPRINGS, COL.—Albert C. Johnson, who says he represents considerable southern capital, has been here looking into the feasibility of building an electric railway from Glenwood Springs to Mt. Sopris, 12 miles south, and has incidentally looked into the practicability of building a similar line over the mountains to Trapper's Lake, about 25 miles north.

LEADVILLE, COL.—The Leadville-Denver Mining, Tunnel & Tramway Company has voted to issue $500,000 worth of bonds for the purpose of building an electric railway from Leadville 6 miles to a point where a tunnel will pierce the mountains for half a mile. This new electric road will cost, with its equipments, $260,000, and will be a connecting line for the steam railroads between Denver and Leadville. It will cut down the distance between the two points mentioned 175 miles by the Denver & Rio Grande Railroad and 40 miles by the Colorado & Southern Railroad. The new line will be equipped for carrying both freight and passengers. The officers of the company are: James A. Shinn, president; Alfred C. Phelps, vice-president; Byron Tifft, secretary. The company is incorporated for $2,000,000.

HARTFORD, CONN.—The board of directors of the Danbury & Harlem Traction Company has elected D. E. Leowe, of Danbury, president; Stephen B. Quick, of North Salem, vice-president; J. N. Cronley, of New York, secretary; Phillip Simon, of Danbury, treasurer. Technical difficulties arising from a transfer of control of the corporation resulted in a cessation of construction work, but it is expected that operations will be resumed this spring.

HILLSBORO, ILL.—Application for incorporation has been made to the Secretary of State for the Hillsboro Electric Railway Company.

CHICAGO, ILL.—Fire recently destroyed the Blue Island Avenue barns of the Union Traction Company. Six hundred cars burned and the building was totally destroyed. The loss will be about $300,000.

SPRINGFIELD, ILL.—Articles of incorporation for the Springfield, Lincoln, Bloomington, Pekin & Peoria Electric Railway Company, with a capital stock of $50,000, have been filed. The principal offices will be located at Bloomington. The incorporators are: Lafayette Funk, of Shirley; D. W. Hart, of Lincoln; A. G. Kingman, of Peoria; J. F. Prather, of Williamsville, and Logan Hay, of Springfield. The board of directors is composed of S. E. Prather, Lafayette Funk, F. W. Aldrich, W. H. Evans, A. G. Kingman and J. W. Hoblit.

INDIANAPOLIS, IND.—The French Lick & West Baden Electric Railway Company has increased its capital stock to $50,000.

COVINGTON, IND.—The Fountain & Warren Traction Company, which plans to build an interurban railroad from Covington east to Lafayette and west to Danville, Ill., is stated to have financed its project, to have made all arrangements for building the line and to have awarded equipment contracts.

KOKOMO, IND.—New officers and directors have been chosen at a meeting of the Kokomo, Marion & Western Traction Company. They are as follows: George J. Marott, of Indianapolis, president; L. J. Kirkpatrick, of Kokomo, vice-president; F. C. McReynolds, of Kokomo, secretary and treasurer; Lee Hall, of Marion, superintendent of construction. It has been decided to proceed at once to extend the line as far east as Bluffton and west to Lafayette and Lebanon the coming season.

INDIANAPOLIS, IND.—The Interstate Traction Railway Company, composed of Ohio capitalists, has filed articles of incorporation with the Secretary of State. The company will build between Dayton, Ohio, and Indianapolis. The road will be 120 miles long. The capital stock of the concern is $50,000. The principal offices of the company will be at Liberty, Ind. The incorporators are: John D. Boroff and W. H. Heinz, of Dayton; E. R. Phillips, of New Carlisle, O., and B. A. Landis, of Camden, O.

LANSING, MICH.—The Indiana & Michigan Electric Company is reported to have been organized in Trenton, N. J., with a capital stock of $2,000,000, for the purpose of furnishing light and power and operating electric railway lines in the states named. The incorporators of the company are: G. W. Flaacke, Jr., H. Hobart Porter, Jr., and Francis Blossom, of Jersey City.

GRAND RAPIDS, MICH.—The Grand Rapids & Ionia Railway Company, Ionia & Owosso Railway Company and the Jackson & Lansing Railway Company are all owned and controlled by the same interests. They will build lines from Grand Rapids to Ionia, from Ionia to Owosso and from Jackson to Lansing, 33 miles, 45 miles and 37 miles long, respectively. No contracts for building any of the lines have been let. The office address of the companies is 1114-17 Majestic Building, Detroit.

LANSING, MICH.—The Lansing & Suburban Traction Company has been incorporated under the street railway law of Michigan, with a capital stock of $1,000,000, for the purpose of taking over the property of the Lansing City Electric Railway, the Lansing, St. Johns & St. Louis Railway, and building a proposed extension from Lansing to Pine Lake, a resort about 10 miles from the city of Lansing. The stockholders of the company are: Nelson Miles and Myron W. Mills, of Maysville; George G. Moore, of Port Huron, and James H. Elliott, of Lansing. James H. Elliott, the present manager of the Lansing Street Railway Company, will, it is understood, be the managing director of the new company.

MAGNOLIA, MISS.—S. E. Shilling and associates are having a line surveyed from Magnolia, through Fernwood, McComb City and Summit, 12 miles, with a view of constructing an electric railway.

JACKSON, MISS.—The Senate has passed the House "Jim Crow" street car bill, which provides that street car companies shall provide separate compartments for whites and blacks.

ST. JOSEPH, MO.—Mrs. Anna Butler, of Des Moines, Ia., representing New York and Cleveland capitalists, who are promoting an electric railway between St. Joseph and Kansas City, and also a new line north of St. Joseph toward the Iowa line, is planning to go before the local Council in behalf of the interests she represents with an application for a street railway franchise.

OMAHA, NEB.—The Omaha & Council Bluffs Street Railway Company plans to dispose of $2,000,000 of bonds when market conditions are favorable, so as to pay for improvements to the property last year and to provide for improvements to be made this year. A new power house, to cost about $500,000, is now under construction, and a number of important extensions of the company's lines have recently been made. The plans of this year provide for carrying out the general improvements begun last year and for building a number of important new lines.

MORRISTOWN, N. J.—The Morris County Traction Company plans to begin the construction of its proposed road Aug. 1. All contracts for building the line and furnishing the equipment have been let. The line will run from Dover to Morristown, Summit and Elizabeth. Power will be hired. Robert D. Foote is president; F. H. Alleman, secretary and manager.

NEW YORK, N. Y.—The New York City Railway Company, of Manhattan, and the Brooklyn Rapid Transit Company, have agreed to co-operate in operating cars over the new Williamsburg bridge. The effect of the agreement is that the two companies will each use two of the six tracks on the bridge for the carrying of their passengers to the opposite bridge terminal, while the remaining two tracks will be used for the running of shuttle bridge cars. The power for these shuttle cars will be supplied by the two companies. Terms satisfacotry to the two companies are yet to be fixed by the Bridge Commission.

NEW YORK, N. Y.—In a circular issued by the Municipal Art Society still another plan for the relief of the traffic congestion on the Brooklyn Bridge is suggested. The idea is to make a loop on Manhattan Island for the tracks now running over the bridge. It is suggested that the north or Manhattan tracks be continued by a curve to the north in descending to a subway at Reade and Elm Streets, and thence passed under the present subway and across under Reade Street to West Street, under West to Liberty, under Liberty to Broadway, under the subway in Broadway, and continuing east to Nassau, under Nassau Street and the east side of Park Row back to and over the Brooklyn Bridge as its southern track. New stations are proposed at Reade Street and Broadway, Reade Street and West Broadway, West and Warren, West and Fulton, West and Liberty and Liberty and Nassau Streets.

OKLAHOMA CITY, O. T.—The latest in interurban electric railway projects here is a plan to build a line to connect Oklahoma City, Lawton, Norman, Shawnee, El Reno and Chickasha. Pennsylvania capitalists, among whom are H. E. Ahrens, of Reading, and J. H. McDonald, of Reedsville, are said to be interested.

KANE, PA.—Another effort is being made to organize a company to build an electric railway connecting Kane, Johnsonburg, Ridgway and St. Mary's.

PUNXSUTAWNEY, PA.—The Jefferson Traction Company has completed securing right of way for an extension of the Punxsutawney & Reynoldsville line from the latter place to Sykesville, a distance of about 6 miles. Work on the extension will be begun as soon as the weather permits. The Jefferson Company has an agreement with the DuBois Traction Company to build a line from that place, which will connect with the Reynoldsville & Sykesville line at the latter place. The DuBois Company will also begin the work of constructing this spring. The Sykesville and DuBois division will be about 9 miles in length.

POWNAL, VT.—The Selectmen of Pownal have granted a franchise to the Bennington & North Adams Street Railway Company for the construction of a line through that town. The company desires to build from Williamstown through the town of Pownal to the Bennington line.

RICHMOND, VA.—The Seaboard Traction Company has been chartered, with a capital of $250,000, to build an electric railway from Richmond to Portsmouth. The principal offices will be at Suffolk, Va. The officers are as follows: L. R. Britt, president; W. H. Robinson, of Norfolk, first vice-president; W. D. Southall, treasurer; Geo. H. Lewis, of Norfolk, general manager; Lee Britt, of Suffolk, secretary and auditor. The line will open a quick outlet for the great trucking interests of eastern Virginia. Power houses will be erected, and part of the power may be secured from the new Appomattox River plant at Petersburg. The charter provides that work shall begin at once. The capital stock may be raised to $800,000.

CHIPPEWA FALLS, WIS.—The Chippewa Valley Electric Railway Company has mortgaged its property for $750,000 to the Security Trust Company, Camden, N. J. Of the sum, $250,000 will be used for building new lines.

MONTREAL, QUE.—Notice is given that application will be made to the Parliament of Canada at the next session for an act to incorporate the Canadian Traction & Power Company, with power to construct a railway from a point in or near the city of Montreal to a point in or near the city of Ottawa, with branch lines. Louis Boyer, of Montreal, is solicitor for the applicants.

NEW INDUSTRIAL COMPANIES.

THE CITIZENS' ELECTRIC COMPANY, of Amsterdam, N. Y., has been incorporated; capital, $50,000. Directors: W. W. Dickson, M. G. Walsh and G. C. Stewart, Amsterdam.

THE NEW YORK & PENNSYLVANIA RAILWAY (reorganized) has been incorporated; capital, $570,000. Directors: F. A. Cobb and Howard Cobb, Ithaca, and H. M. Cook, Hornellsville.

THE EDGERTON ELECTRIC MOTOR MANUFACTURING COMPANY, of Philadelphia, has changed its name to Dialt Motor Company and increased its capital stock from $300,000 to $1,250,000.

THE SWITCHBOARD MANUFACTURING COMPANY, of New York, has been incorporated with a capital stock of $15,000. The directors are: August Schraam, Louis Freund and Ernst Ohnell.

THE STUDEBAKER AUTOMOBILE COMPANY, South Bend, Ind., has filed articles of incorporation with the Secretary of State. The capital stock is $100,000. The company will manufacture and sell automobiles.

THE REPUBLIC BUILDING COMPANY has been organized in Cleveland, O., with a capital stock of $500,000. The purpose of the company is to erect a 10-story power building for light manufacturing concerns.

THE ROBBINS ELECTRIC COMPANY has been incorporated at Washington, D. C., with a capital stock of $150,000, the names of the incorporators being H. Clay Campbell, Charles Embrey and Ralph E. Campbell.

THE RIO DE JANEIRO TRAMWAY, LIGHT & POWER COMPANY has been incorporated in Jersey City; capital, $200,000. Incorporators: Horace S. Gould, Otho S. Lee, Edgar E. McWhinnery and Charles A. McCredy.

THE GLOBE ELECTRIC COMPANY has filed incorporation papers at Camden, N. J. Its purpose is to deal in and sell electrical machinery. The capital is $100,000. The incorporators are Henry S. Riebenack, W. C. L. Eglin and James E. Hays.

THE WARREN & JAMESTOWN STREET RAILROAD COMPANY (merger and reorganization) has been formed at Jamestown, N. Y.; capital, $200,000. Directors: David M. Siggins and H. M. Preston, Warren, Pa., and C. H. Clifford, Jamestown.

THE ELECTRIC SUPPLY COMPANY has been chartered at Savannah, Ga., with a capital stock of $25,000, with the privilege of increasing to $100,000. The purpose of the company is to carry on a general electrical supply and repair business with headquarters at Savannah.

THE ELECTRIC BLOCK RAILWAY SIGNAL CORPORATION has filed incorporation papers at Augusta, Me., with a capital stock of $10,000. The officers are: President, F. C. Robinson, Farmington, Me.; treasurer, W. H. Cook, Farmington, Me.; director, E. H. Whitney, Farmington, Me.

THE EASTERN ILLINOIS TRACTION COMPANY has been incorporated at Mattoon, Ill., with $5000 capital. The road will run from Mattoon, Coles County, to Champaign, Champaign County. E. A. Potter, of the American Trust & Savings Bank, Chicago, is one of the incorporators.

THE INDIANA & MICHIGAN ELECTRIC COMPANY has been incorporated in Jersey City; capital, $2,000,000. Incorporators: George W. Flaack, Jr., H. Hobart Porter, Francis Blossom, Herman L. Crawford, Lyman J. Dwyer, Frederick P. Delafield, Frederick W. Longfellow, Henry C. Colwell and Harold S. McKee.

LEGAL.

TO REORGANIZE.—The business of Robert L. McOuat, wholesale dealer in electrical supplies at 125 S. Meridian Street, Indianapolis, Ind., has been turned over to A. F. Potts, as trustee, for reorganization. The trustee will continue the business until the new company takes charge.

LANGE LAMP SOCKET PATENT SUSTAINED.—The Lange patent on the present method of fastening together the cap, shell and insulation of incandescent sockets has been sustained in a decision of the United States Circuit Court of Appeals of the Third Circuit. The present owners of the Lange patent are the Bryant Electric Company.

THE W. H. SMITH COMPANY, Indianapolis, Ind., dealer in electrical supplies and power equipment, has been placed in the hands of a receiver—Mr. George B. Elliott—on the petition of the Gillmore Electric Company, of South Boston, Mass. The prolonged illness of President W. H. Smith is given as the reason for the concern's embarrassment.

COMPETING TELEPHONE LINES.—The Supreme Court of Iowa has held that where neither of two telephone companies had the exclusive right to string its wires along a particular side of a street or highway, it was proper for the court to require that their wires should be constructed a sufficient distance fom each other so that the use of one would not unreasonably interfere with the use of the other.

INDIANAPOLIS, IND.—A suit has been filed here asking for a receiver for the Edwards Railroad & Electric Light Company. The company was incorporated under the laws of Indiana and has its business office in Chicago and its factory in Ohio. The company was organized to manufacture and repair steam engines, electric dynamos, electric arc lights, etc. The complaint charges that the company has violated the corporation laws of the three States; also mismanagement.

ERECTING POLE LINE.—The Supreme Court of Pennsylvania, in the suit of the city of New Castle, Pa., vs. the Central District and Printing Telegraph Company, decided as follows: 1. A city may provide by reasonable regulations for the use of its streets by a telegraph or telephone company. 2. An ordinance that a telephone company may apply to the council to have its poles located, and that the council may designate the location of each pole, or authorize the street committee or the city engineer to make the location, is not invalid, as preventing the company from erecting poles in any street in the city, or impairing its right to so do. 3. A city ordinance required that telephone poles should be located under the approval of the city engineer, and under his supervision. A mere verbal approval by the engineer of a general plan showing the place where the poles were to be erected does not authorize their erection at the points designated without further supervision by the city engineer.

LEBANON, IND.—Judge Artman, of the Boone Circuit Court, has rendered a decision of great importance to the telephone men in Indiana. There are two telephone companies in Thorntown, and one in Lebanon. The cities are 16 miles apart. The Lebanon Telephone Company entered into a contract with the Thorntown Independent Company whereby the latter was to be granted exclusive service between Thorntown and Lebanon. Then the Thorntown Co-operative Company applied for admission to the Lebanon Company's switchboard, but was refused because of the contract with the other company. The Co-operative Company then applied for a writ of mandate to compel the Lebanon Company to admit it to its switchboard, alleging that the Lebanon Company was a common carrier and could not discriminate against companies. In making up the issues of the case two months ago, Judge Artman held that if the allegations in the complaint were true the Lebanon Company was a common carrier, and as such would be bound to grant connection to all companies seeking admission. However, the case went to treat on the question of facts, and after taking the matter under advisement for two months Judge Artman rendered a special finding holding that the allegations in the complaint were not sustained; that it had not been established that the Lebanon Telephone Company was a common carrier, and for these reasons his decision must be for the defendant and the petition dismissed. The case will be appealed to the Supreme Court.

DUTY AS TO BROKEN WIRE. On the appeal in the case of a man who had been killed by contact with a broken wire of an electric light company in a storm, the Supreme Court of Louisiana has ruled as follows: A wire of an electrical company, detached from the poles and lying in the streets of a town, is, of course, out of place, and those having control of it and charged with the legal duty of taking due care of it have the burden of accounting for its being found in that condition and situation (Maus vs. Broderick, 25 South. 977, 51 La. Ann. 1153), and to show that it was not due to its negligence. It is the absolute duty of an electric light company conveying electricity by overhead wires strung through the streets of a city to keep its wires constantly insulated so as to be prepared to guard against the effect of objects coming in contact with them regardless of the facts and causes which may bring about the contact. The fact that a telephone company may have strung its wires above those of the electric light company already in position, and should have taken no steps to guard against the coming in contact of the wires of the two companies at the crossing points, and that in stringing its wires it did so negligently and loosely that one of its wires fell, in a storm, upon an uninsulated wire below, causing it to burn and fall on the street, is no excuse to the electric company in not having performed its own duty of additional and special precautions in the premises. A fault on the part of the telephone company did not relieve it from the consequence of its own fault. The falling of the telephone wire on the wire below would have been attended with no disaster but for the uninsulated condition of the latter, and that condition is to be attributed as the proximate cause of the death of the husband and father of the plaintiffs.

ORDINANCES FOR LIGHTING.—In an action by J. Le Feber, et al, against the Northwestern Heat, Light & Power Company, et al, as to a franchise granted, the Supreme Court of Wisconsin has reversed a judgment for the defendants. The place was West Allis, Wis., and the ordinance was assailed as unreasonable. The Supreme Court's views are: 1. Though the discretion of municipal corporations in the exercise of the powers conferred upon them by the Legislature will be given a broad scope and accorded great deference by the courts, nevertheless that power must be exercisd for public purposes and, if an ordinance be so remote from such purposes that no relation thereto can be discovered, it will be held unauthorized and invalid. 2. A village ordinance granted to a certain company the exclusive right to furnish lights for the city and its inhabitants for a period of 30 years, and if, within a period of four months immediately preceding the expiration of the 30 years, the city should fail to make arrangements to purchase the plant, then for an additional period of 20 years. The village was located within a few miles of a large city, and had come into existence because of the location there of large manufacturing establishments. The electric street car lines from the city had been extended to the village at the time the ordinance was passed. The prices which the ordinance authorized the company to charge for the various kinds of light which it was to furnish were from 30 to 75 per cent. in excess of those paid elsewhere under similar circumstances, the greatest excess being upon the only variety of lights which the company could be compelled to furnish. The contract contained no provisions by which the village could compel the company to extend its gas mains or electric wires or to furnish any other than gasoline lights. It was provided that the company should commence active work within five months from the time the ordinance was accepted, but there was no provision as to when such work should be completed. The village had sufficient inhabitants to make it a city, though the fact could not be established until a State census was taken; and Rev. St. 1898, Sec. 925-52, subd. 34, provides that cities shall not make lighting contracts for a longer period than 10 years. Held, that the ordinance was void for unreasonableness. 3. The grounds of the invalidity of the ordinance so permeated the whole, and were so interdependent, that the unreasonable and illegal features could not be eliminated so as to allow the remainder to stand. 4. The fact that a village ordinance has been submitted to a popular vote and assented to by a majority of the electors of the village does not prevent it from being held void as unreasonable.

PERSONAL.

ARTHUR WARREN.

MR. ARTHUR WARREN.—In enlarging extensively its sphere of operations, the Allis-Chalmers Company has found it desirable to increase the scope of its Publishing Department, and it has been fortunate enough to secure the services of Mr. Arthur Warren, whose work in the field of technical journalism and whose success as what one may perhaps call a "publicity promoter" is too well known to everyone in the electrical field to need dwelling upon. Mr. Warren is a Bostonian with remarkable qualifications for the work to which he has of late devoted himself. Coming of a family of considerable mechanical aptitude and distinction, he prepared himself for the technical side of his work by actual machine shop practice. After this he began to travel, and while traveling wrote about things which he saw. The transition to journalism was easy, and in 1883 Mr. Warren joined the staff of the *Boston Herald*, then as now one of the most influential journals in the country. With this newspaper he remained for 14 years, becoming its leading special article writer and discussing not only economic topics, but venturing into the fields of biography and of dramatic and literary criticism. Meantime Mr. Warren took up other editorial work and was assistant editor of the *Beacon*, a well-known Boston weekly, and from 1886 to 1888 editor of the *Boston Home Journal*. In December, 1888, Mr. Warren was sent abroad by the *Boston Herald* as its London correspondent, in which capacity he served it most efficiently for some nine years, besides writing for a number of other American and British publications. His London home, which he still retains, was thus for many years a charming center of social and literary intercourse, in which many famous Americans and Europeans participated. In November, 1897, Mr. Warren returned to the United States at the invitation of Mr. George Westinghouse, a man quick to recognize the talent suited to carry out important new plans; and he immediately proceeded to organize the Westinghouse Publication Bureau, whose record of solid achievement in the way of publicity of the best kind as to articles, pamphlets, advertising and the diplomatic aspects, has certainly never been surpassed. In February of this year, his work in that connection both in this country and in England being practically completed along the original lines laid down, Mr. Warren resigned. He has been actively engaged since then in this city on literary work of all kinds for the leading magazines and newspapers, and had planned to sail for Europe on March 12, when he was invited by the executive of the Allis-Chalmers Company to become manager of publicity for that corporation under its new regime. The field of available talent had been thoroughly looked over, and it was felt that by training and experience Mr. Warren was the man for the very important post. Mr. Warren has accepted the offer, and has already taken up his new duties. While he may himself entertain regrets at not following up the purely literary work offered him in really embarrassing abundance, it is a matter of congratulation that he will devote his time and energies to the publicity side of one of the greatest and most comprehensive mechanical enterprises in the United States.

MR. M. L. MORA, of the General Electric Company, is in Cuba. He is expected back in a week or ten days.

MR. W. K. PALMER, the well-known consulting mechanical and electrical engineer in Kansas City, has moved his office to 402 Lyceum Building.

MR. JAMES BLAKE CAHOON, electrical and hydraulic engineer, has removed his offices to suite 1725-6, in the new building, 42 Broadway, New York.

MR. W. MURRAY CRANE has been elected a member of the board of the Western Telephone & Telegraph Company, to succeed the late J. Malcolm Forbes.

DR. S. S. WHEELER, president of the Crocker-Wheeler Company of Ampere, N. J., has sailed this week for Europe, and will be gone for some six weeks on the trip.

MR. H. K. WOOD, of the Hartford Time Switch Company, Hartford, Conn., was in New York for a day or two last week. On this occasion he arranged with F. H. Lovell & Co. to represent his switch and his company in New York City.

MR. T. A. EDISON.—The report has been so widely circulated that he was going to London in May, that Mr. Edison, now on his plantation in Florida, has felt compelled to make a flat contradiction of the rumor sent over by cable.

MR. HAROLD D. PATTERSON, formerly superintendent for Mr. Max Osterberg, has become connected with the United States Battery Company of New Rochelle, N. Y., in the capacity of electrical engineer, and has assumed his new duties.

MR. H. C. TUNNELL.—The Lincoln Electric Company, of Cleveland, O., announces that its New York representative is Mr. H. C. Tunnell, 65 Bank Street, Newark, N. J. The Lincoln Company has manufactured dynamos and motors for some years past.

MR. CORNELIUS C. VERMEULE, 203 Broadway, is back from Cuba, where he recently went in connection with the construction of the Cienfuegos, Palmira and Crucas Electric Power and Railway Company, of which concern he is the consulting engineer.

MR. D. J. BURNS, of the Ward Leonard Electric Company, Bronxville, New York, recently arrived in New York after an extensive trip in the West and Southwest. He reports that business conditions in general are good, while they are excellent with respect to the affairs of his company.

MR. G. H. MUNROE.—New York newspaper men and special representatives of the leading newspapers out of the city were entertained at dinner at the Waldorf-Astoria on March 14 by George H. Munroe, of the banking firm of Munroe & Munroe, who managed the underwriting of the Marconi company.

MR. W. S. TURNER, manager and engineer at Auckland, New Zealand, for the British firm of J. G. White & Co., for some time past, has returned to New York after staying also some months in London. While in New Zealand Mr. Turner superintended the construction of a fine street railway system for Auckland.

MR. CHARLES M. SWIFT, of Detroit, Mich., who is president of the Manila Railway, Light and Power Company, has gone on a trip to the Philippines to inspect the progress made in the construction of the company's system, the contract for which is being carried out by J. G. White & Co., of New York City.

MARKS—VAN PRAAG.—The marriage took place on March 15, of Mr. Louis Benedict Marks, of New York City, to Miss Sadie Van Praag, daughter of Mr. and Mrs. Leon A. Van Praag. The happy pair are now on their honeymoon. Since perfecting his work on the enclosed arc, Mr. Marks has been practicing as a consulting electrical engineer.

MR. RAY D. LILLIBRIDGE, who has been making a two months' trip through the West, visiting particularly the power transmission plants of the Pacific coast and Colorado, has just returned home to New York much benefitted by the change. In behalf of the Stanley Company Mr. Lillibridge has prepared and issued some most interesting technical literature as to power transmission plants on the Pacific Slope.

MR. ARVID REUTERDAHL is the author of two recent pamphlets, one of which is entitled "The Radioactive Atom," and the other "Electrolysis According to the Energonic Hypothesis." In the former of these Mr. Reuterdahl develops a new and radical theory of the constitution of matter and the role of energy. The latter presents criticisms against the accepted theory of electrolytic dissociation, and offers a substitute based upon a new hypothesis concerning the ultimate constitution of matter.

MR. J. H. HALLBERG has severed his connection with the Cincinnati Gas & Electric Company. Less than a year ago, he took charge of the Cincinnati system, one of the largest in Ohio and in the country, as general superintendent of the electrical department. He reorganized the station, increased the output of the plant, straightened out the system of feeders, increased the economy of operation and obtained the respect and admiration of all who came in contact with him, for his ability and honesty of purpose. At the last meeting of the Cincinnati chapter of the American Institute of Electrical Engineers, he was elected vice-chairman. Mr. Hallberg, who resigned last week, intends to leave Cincinnati, it is said.

MR. C. O. BAKER, JR., for so many years the popular and efficient master of transportation for the National Electric Light Association, has resigned from that position. Mr. Baker expects to be in Europe at the time of the Boston meeting, to be held May 24-27 next, and feels that he should not continue in the office unless he can personally attend to the duties connected with it. President Edgar has appointed Mr. George F. Porter to succeed Mr. Baker. Mr. Porter had charge of transportation matters before he became secretary of the association, and organized special trains for the Philadelphia convention, February, 1887, the Chicago convention, February, 1889, and the Kansas City meeting, February, 1890. During the ten years that he was secretary, he had more or less to do with transportation arrangements, and being very popular with the railroad people as well as with the delegates to conventions, his appointment is another instance of President Edgar's good judgment in the selection of willing men to work for the welfare of the association.

MR. PHILETUS W. GATES and Mr. Henry W. Hoyt, respectively general superintendent and second vice-president of Allis-Chalmers Company, are about to retire from active participation in the management of that company. Mr. Gates was president and Mr. Hoyt secretary and general manager of Gates Iron Works for fifteen years prior to the incorporation of Allis-Chalmers Company in 1901. They have been prominently connected with the manufacturing interests of Chicago and have taken an active part in all of the manufacturers' associations. The late P. W. Gates (father of Philetus W. Gates) was the pioneer manufacturer of Chicago and the region west of the Alleghenies, having established his business in 1842. From 1861 to 1871, the Eagle Works Manufacturing Company, of which he was president, employed about one thousand men, and in those days was a noteworthy industry. In 1871 the Eagle Works Manufacturing Company went out of existence and from it were organized Gates Iron Works and Fraser & Chalmers, each taking a portion of the business. Both of these companies in turn were taken over by Allis-Chalmers Company in 1901. Messrs. Hoyt and Gates, after a well-earned vacation spent in traveling, will re-engage in business in Chicago.

COMMANDER B. A. FISKE, U. S. N.—In the first edition of the "Text Book of Ordnance and Gunnery," prepared by Lieut. Commander W. F. Fullam and Lieut. T. C. Hart, U. S. N., for the use of midshipmen at the Naval Academy, a very brief reference was made to the history of the telescope sight, and the first of a series of patents, made by Lieut. (now Commander) Bradley A. Fiske, U. S. N., in 1890, was mentioned. Commander Fiske is widely known in electrical circles. It is with a view to giving well deserved credit to Commander Fiske for originating, and for persisting in the advocacy of the telescope sight for naval guns, that the following note (addendum) has now been inserted in the "Text Book of Ordnance and Gunnery:" "Addendum: Par. 7, page 233, Text Book of Ordnance and Gunnery, 1903, 'The Telescope Sight.' It is but just to Lieutenant (now Commander) Fiske to state that to him belongs the credit for first demonstrating the fundamental advantages of this type of sight over all kinds of open sights for naval use. Following the patent of 1890, he obtained four patents between 1891 and 1895 in which he provided for attaching the telescope to the gun sleeve and for making compensation for drift and speed; and he proved the practicability of using this form of sight for naval guns by official tests at sea during the years 1892, 1893 and 1894. The Bureau of Ordnance of the U. S. Navy was the first to recognize the value of this invention; and it is plain that the essential principles of the latest type of naval telescope sight do not differ from those covered by Lieutenant Fiske's patents, which were embodied in his original instruments."

EDUCATIONAL.

DELAWARE COLLEGE, DEL.—The Department of Mechanical and Electrical Engineering has during the past few weeks added to its equipment in the dynamo laboratory some useful apparatus. This has been given through the interest in the electrical work at Delaware College of certain manufacturing companies, principally the Baldwin Locomotive Works, of Philadelphia; the Joseph Bancroft & Sons Company, Rockford, Wilmington, and the E. I. Dupont de Nemours & Company, Wilmington. This apparatus includes one 5 horse-power continuous-current shunt-wound motor from the first of the above companies and two small motors and a voltmeter from the Bancroft works. The larger part, however, comes through the courtesy of Mr. Alfred Du Pont, namely, one 2 horse-power direct-curent motor, two transformers, complete patterns for an alternator of 40-kw capacity, four La Roche meters and one Queen & Company ammeter. The department has also recently received from the Navy Yard, New York, a standardized 32-cp lamp for accurate testing with the photometer, and a hydraulic ram from the Gould's Manufacturing Company, Seneca Falls, N. Y. The apparatus for the dynamo laboratory, while not for the most part of the latest designs, will however enable work under Prof. A. J. Wood to be carried on much more successfully than it could without this additional equipment.

Trade Notes.

THE POLICE TELEPHONE & SIGNAL COMPANY, of Chicago, has changed its name to Chicago Fire Alarm Company.

THE WILLARD STORAGE BATTERY COMPANY, Cleveland, O., will supply the storage batteries for the electric launches at the St. Louis World's Fair.

OIL FILTERS FOR FRANCE.—A cable order from Paris, France, for a large shipment of Cross oil filters has been received by the Burt Manufacturing Company.

THE HERTNER ELECTRIC COMPANY, Cleveland, O., has closed a contract for some special motors for the operation of electric launches at the St. Louis Fair.

THE STERLING ELECTRIC COMPANY, Lafayette, Ind., has just completed the installation of common battery equipments at Gainesville, Tex.; Denton, Tex.; Springfield, Ohio, and Elyria, Ohio. It reports a good demand for this class of work for the coming year.

STORAGE BATTERIES FOR RAILWAY PLANTS.—The Electric Storage Battery Company, Philadelphia, devotes its Bulletin No. 81 to a description of the installation of Chloride accumulators for the San Francisco, Oakland & San Jose Railway Company. The plant is well illustrated.

THE H. O. S. ENGINEERING COMPANY, 88 Warren Street, New York, is sending out to the trade its bulletin No. 41, relating to covers for "H. O. S." panelboard cabinets. Three styles of these covers are illustrated and general data as to cabinets and covers are given. Tabulated price lists and code words are also included.

THE STANDARD ELECTRICAL MANUFACTURING COMPANY, of Niles, O., has opened a New York office at 19 Park Row with Mr. J. Rice, general sales manager in charge. Stock will be carried for quick delivery and particular attention given to pushing the Standard Company's latest additions to its lines—the 3¼-inch frosted bulb reflector lamp.

RAILROAD BONDED INDEBTEDNESS.—Poor's Railroad Manual Company, New York, has issued a supplement to its Manual of Railroads, giving a great deal of information about railway bonded indebtedness. It contains all important facts required by investors, bankers and others relative to the financial status of the leading railway systems in the United States.

"GOOD MOTIVES" is the title of a little double-fold pamphlet of recent issue by the Peerless Electric Company, Warren, O. The subject is Peerless motors, and the illustrations show motors of different sizes, and motors coupled, either by belt or gearing, to machine tools of various kinds. The text matter is an interesting argument in favor of the "Peerless" machines. The company's fan motors, transformers and lamps are also well known to the trade.

PHOSPHOR-BRONZE.—Price list No. 22 of "Elephant Brand" phosphor-bronze has been issued by the Phosphor-Bronze Smelting Company, Ltd., 2200 Washington Avenue, Philadelphia, Pa. It is replete with information regarding phosphor-bronze in rolls and sheets, wire, rods, wire rope, ingots, castings, etc. The company's new rolling mill is now in successful operation. The company carries on hand a well-assorted stock of manufactured goods for prompt supply.

THE EAGER ELECTRIC COMPANY, Watertown, N. Y., has issued a neat catalogue on the subject of its direct-current generators and motors for lighting and power. The generators are of the direct-connected or belted types. The company also makes motor generators, plating dynamos and boosters. These machines are of excellent design and are illustrated. The catalogue gives complete information and data regarding the various types of machines produced by the company.

McLEOD, WARD & COMPANY, 27 Thames Street, New York, in a little pamphlet admonish the readers thereof to save their eyes. While the admonition is quite justifiable these strenuous days, the pamphlet points to a way to put the suggestion into practice, namely, by using the Kinsman type of lamp as manufactured by this firm. The desk lamps of this firm are extensively used and well known. This pamphlet gives complete information regarding these lamps in their different styles.

"BEFORE AND AFTER."—An attractive pamphlet has been issued by the Calculagraph Company entitled "Before and After." This title refers to the use of the Calculagraph for timing telephone toll messages. It tells a little story as to what was done by the old method of figuring and comparing time tickets and the great saving that was effected when the Calculagraph took all of this mechanical work from the operator. The pamphlet is a convincing argument for the use of the Calculagraph.

MINE AND ORE CARS.—The Atlas Car & Manufacturing Company, Cleveland, Ohio, has issued a very completely illustrated catalogue of its products, which consist of dump cars of every description for smelting and roasting plants, furnaces, foundries, cement works and general use, also overhead trolleys, industrial railway equipment, frogs, switches, rails, etc. The illustrations show this varied line of articles, each one being accompanied by a description, data, etc. The catalogue (No. 1018) has over 100 pages and covers the ground very thoroughly.

POWER TRANSMISSION APPLIANCES.—Price list No. 10 of power transmission appliances of the Case Manufacturing Company, Columbus, Ohio, takes up no less than 136 pages. There is a vast number of articles listed, and the final production of this list represents a great amount of time, labor and care. The pages are of a bright yellow paper, which is very pleasing to the eyes. Among the articles included may be mentioned: hangers, bearings, belting, bolts, conveyors, couplings, gears of all kinds, elevators, power shovels, jacks, pulleys, transmission rope, scales, truck, etc., etc.

GAS ENGINES.—The Walrath gas and gasoline engines as manufactured by the Marinette Iron Works Manufacturing Company, Marinette, Wis., have become pretty well known since their introduction to the market. The engine possesses many features that appeal to power users the more they become known. A catalogue issued by the company gives detailed information regarding this well-known type of engine, and several illustrations show the different designs. Engines direct-connected to electric generators are also shown. One of the engines shown, of the 3-cylinder type, is of 150 horse-power.

WIRES AND CABLES.—The Hazard Manufacturing Company, Wilkesbarre, Pa., gives very complete information—much of it in tabular form—of its extensive line of products, in a neatly gotten up pamphlet of recent issue. This company, as is well known, manufactures electric wires and other equipment for electric railways, electric light and power circuits, telephone and telegraph systems. All copper wires used in the manufacture of its insulated wires and cables are drawn in the company's own wire mill. The pamphlet is copiously illustrated, showing sections of cables of many varieties and for all purposes. The pamphlet is replete with tables.

THE WILLARD STORAGE BATTERY COMPANY, of Cleveland, is now fully settled in its new plant at the corner of St. Clair and Water streets. There are two buildings, embracing over 25,000 sq. ft. of floor space. The company has recently installed a large amount of new special machinery, and is now prepared to handle more than double its former output. It is manufacturing batteries for all purposes and just now is doing an unusually large amount of work for railway signal outfits, electric launches and electric automobiles. Improved processes of manufacture and close attention to mechanical details have resulted in a considerable decrease in the weight of the Willard battery and at the same time the efficiency has been increased.

KELLER, PIKE & CO., of Philadelphia, have been awarded the contract for the complete mechanical and electrical equipment of the new Court House for Camden County, N. J. This building, which has been designed by Messrs. Rankin, Kellogg & Crane, will cost about $700,000. The equipment consists of return tubular boilers of 300 hp, two simple high-speed engines, two direct-connected 55-kw. generators, foundations, switchboard, power steam piping, heating and ventilating systems, with Johnson temperature regulation, electric motors for fans, blowers and pumps, electric elevators, and electric light and power wiring. It will be recalled that the same company recently secured the large contract for the new Pennsylvania state capitol.

H. W. JOHNS CONVENTION.—The H. W. Johns-Manville Company held a convention last month at New York and Hartford, Conn., of its branch managers, department managers and salesmen. The company has issued a pamphlet giving a report of the meeting. The programme was a varied and extensive one, the subjects of the papers referring to matters directly or indirectly related to the company's field of work. Representatives to the number of about 35, from all parts of the country, were present. The object of the convention was to bring all branches into closer touch with one another and to afford opportunity for a general discussion of all the greatly varied lines manufactured by the company. The meetings were held at Hartford on February 15, 16 and 17, and at New York on February 18, 19 and 20.

HYDRO-CARBON PAINTS.—The Hydro-Carbon Manufacturing Company, Denver, Col., has just issued a couple of small pamphlets relating to its hydro-carbon paints, their advantages and uses. It is stated that this paint possesses to a high degree the property of withstanding extreme climatic conditions and yet retains its preservative value. The basis of the paint is a hydro-carbon ore, which is stated to be a natural product of petroleum mined in Utah and Colorado. It is claimed that the paint resists the corrosive action of steam, vapor, water and gases. One of the pamphlets is given up entirely to a dissertation on iron corrosion and its prevention. The information given on the general subject is valuable to those concerned. The Hydro-Carbon Manufacturing Company will be glad to send copies of these pamphlets on application.

STURTEVANT CATALOGUE.—The second edition of catalogue No. 115, the general condensed catalogue of the B. F. Sturtevant Company, Boston, Mass., is now ready for distribution. This catalogue describes and illustrates a number of new apparatus manufactured by this enterprising company, among which are a new type of hand-blower, several new types and sizes of forges, new sizes of vertical single and double engines, a new type of enclosed vertical compound engines, new type of semi-enclosed bi-polar and 4-pole motors, new sizes of generating sets with vertical compound engines, factory equipments, such as bench-legs, pattern storage shelf brackets, electric hoists, cast iron sinks, trench cover-plates, etc.; industrial railway equipments, such as cars, truck ladles, turntables, T-rails, etc. It also contains a description of the various Sturtevant systems, such as heating and ventilating, special ventilating, drying, conveying and mechanical draft systems.

THE NATIONAL ELECTRIC COMPANY, successor to the Christensen Engineering Company, Milwaukee, will exhibit its electrical and air brake apparatus at the St. Louis Fair. Part of its electrical exhibit will include a 1500-kw alternating-current generator. This unit will be in operation at the central power station, furnishing power for various purposes. In addition, a number of smaller alternating and direct-current machines will be exhibited at its space, including a very complete exhibit of the Christensen air brake equipment, so well known in the street railway field.

THE WELLMAN-SEAVER-MORGAN COMPANY and the Electric Controller and Supply Company, of Cleveland, are now occupying a handsome and spacious office building erected exclusively for their use adjoining the plant on the Pennsylvania tracks and Central Avenue, Cleveland. The Electric Controller & Supply Company occupies practically one entire floor, including general office room, six private offices and large drafting room. All rooms in the building are illuminated with Nernst lamps and over each table in the drafting rooms are single glower Nernst lamps suspended from cords. The drafting rooms are connected by dumb waiter with the blue-print room in the basement, which is provided with electric blue-print machines. In the basement there are dining rooms for officials and office employes. On each floor there are two toilet rooms, and there is a private bath room and barber shop for officials. There is a private telephone exchange connecting all offices and departments in the building, as well as throughout the plant, and there is a Postal telegraph office in the main entrance. The various offices are equipped with every convenience and are tastefully and handsomely furnished.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MARCH 15, 1904.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

754,406. ELECTRICALLY OPERATED STOPPING MEANS AT RAILWAY DANGER SIGNALS; William L. Adamson, Philadelphia, Pa. App. filed June 12, 1903. When the signal at the roadside is thrown to danger from a tower, a contact is at the same time thrown into position to be struck by a train to close a circuit which shuts off the steam on the locomotive and prevents the train from running past the signal.

754,414. OUTLET FOR INTERIOR CONDUITS; William F. Bossert, Utica, N. Y. App. filed Dec. 19, 1903. A sheet metal sleeve is adjustable in position in the front opening of the box to be made flush with the plaster.

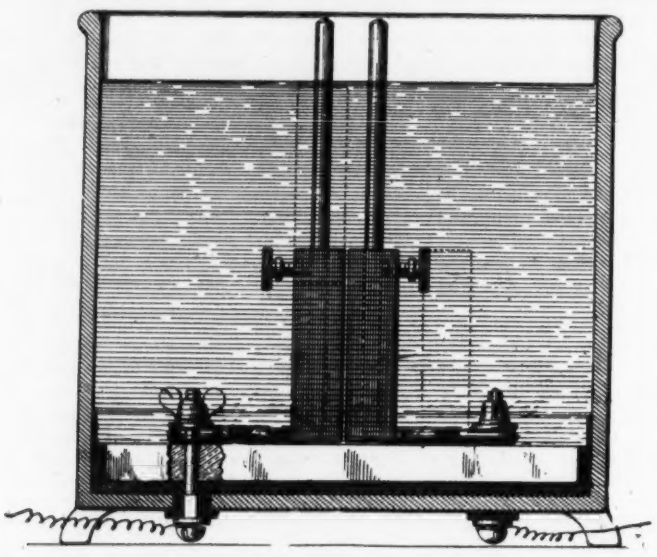
754,429. MEANS FOR ELECTRICAL DISTRIBUTION; John L. Creveling, New York, N. Y. App. filed May 10, 1901. A centrifugally operated circuit controller and rheostat for train lighting systems.

754,451. ELECTRICAL WATER HEATER; Harry M. Hill, St. Louis, Mo. App. filed June 1, 1903. Two carbon electrodes adjustably mounted in a tank; the water circulating between them becomes heated by the passage of current.

754,465. AUTOMATIC ELECTRIC HEAT REGULATOR; Daniel N. Leib, Elkhart, Ind. App. filed April 10, 1902. Details.

754,473. GUIDE WHEEL; Alexander H. Mathesius, Brooklyn, N. Y. App. filed Feb. 14, 1901. The shape of the tread of a trolley wheel and the cross section of the conductor are so related as to reduce slipping and abrasion of the contact surfaces.

754,496. LIMITING DEVICE FOR ELECTRIC CIRCUITS; Charles W. Potter, Denver, Col. App. filed Feb. 10, 1902. A device applied in the meter loop which is adjusted so that upon an increase of the load above the amount contracted for, the device will automatically cut off the current.



754,451.—Electrical Water Heater.

754,505. AUTOMATIC CIRCUIT BREAKER; William M. Scott, Philadelphia, Pa. App. filed June 18, 1903. Various improvements in the details of construction.

754,534. THERMOSTATIC GAS DETECTING MEANS; James E. Baldwin, East Williston, N. Y. App. filed Sept. 10, 1902. Details.

754,555. AUTOMATIC FIRE ALARM; Mason K. Fred, Pleasanton, Tex. App. filed March 9, 1903. A protective fusible wire is connected in parallel with an alarm and a resistance and in series with a battery; the resistance normally prevents the alarms from ringing, but the destruction of the fuse wire sends the entire current through the alarm.

754,565. ELECTRIC RAILWAY; Rudolf Alfred Emil Haber and Hans Hugo Carl Behn-Eschenburg, Zurich, Switzerland. App. filed Dec. 23, 1901. An application of the Ward Leonard railway system relating to the use of alternating current line sections of different voltages; for example, a high voltage for the open country and a low voltage for large railway stations.

754,596. GAS DETECTOR; George A. Nelson, Providence, R. I. App. filed Feb. 10, 1903. A balloon which floats in a normal atmosphere will lower in the presence of a gas and close an alarm circuit.

754,622. ELECTRIC CLOCK; David W. Thompson, Chicago, Ill. App. filed Dec. 5, 1895. Details.

754,631. LAMP FOR CANES, UMBRELLA STICKS OR THE LIKE; James W. Allen, St. Louis, Mo. App. filed Nov. 2, 1903. A bull's-eye electric lamp and battery all located in the head of the cane.

754,656. ELECTRIC FURNACE; Charles Albert Keller, Paris, France. App. filed Jan. 17, 1902. (See page 608.)

754,660. RHEOSTAT; Lamar Lyndon, New York, N. Y. App. filed Aug. 8, 1902. A rheostat which by being properly connected with a translating device and the line, will permit the total current to flow through the device when it is desired, and with which it will be possible to vary at will the potential of the current in the device from zero to maximum.

754,666. INDUCTION COIL; Reuben Miller, Jr., Pittsburg, Pa. App. filed Jan. 7, 1904. A magnet operating an interrupter is in circuit with all of the primaries of a number of induction coils, supplying the spark respectively to the cylinders of a multiple-cylinder engine.

754,681. ELECTROMAGNETIC DEVICE; Eugen K. Muller, Zurich, Switzerland. App. filed Sept. 20, 1902. Details of an alternating-current magnet adapted for massage purposes.

754,689. ELECTRIC SELECTIVE APPARATUS; Frank D. Pearne and Charles L. Krum, Chicago, Ill. App. filed Feb. 3, 1902. A sensitive relay by which one or two or three branch circuits may be closed in combination with a magnetic lock arranged to hold the selected branch in a closed condition.

754,692. RHEOSTAT; Claude R. Pitrat, Amsterdam, N. Y. App. filed Aug. 8, 1903. Details.

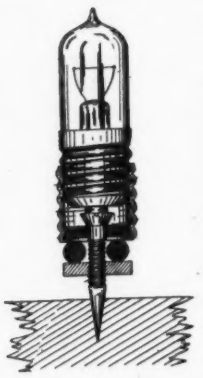
754,694. ELECTRIC POCKET LAMP; Angelica E. Post, Boston, Mass. App. filed Dec. 30, 1903. A flat battery case for the vest pocket, the cover having a lamp which can be thrown into circuit at will.

754,756. PROCESS OF SEPARATING ORES FROM MAGNETIC GANGUE; Thomas A. Edison, Llewellyn Park, N. J. App. filed May 29, 1903. App. filed March 15, 1903. The small proportion of non-magnetic material in a body of ore is recovered by first grinding to a fineness to free the non-magnetic particles, then adding a larger bulk of the coarser non-magnetic material, then passing the mixture through a magnetic separator to separate the entire body of non-magnetic material and finally separating the coarser material from the original non-magnetic material.

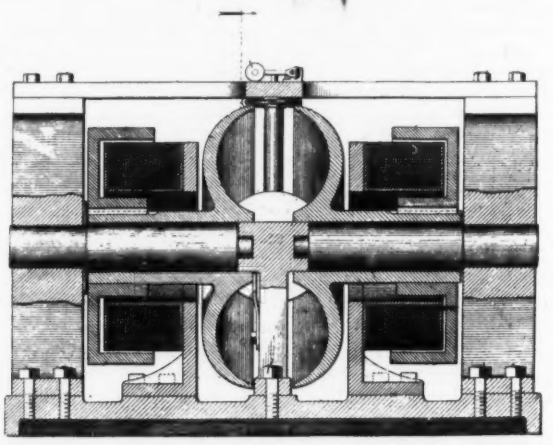
754,762. ELECTRIC SOCKET SUPPORT; Edwin R. Gill, New York, N. Y. App. filed March 14, 1902. A lamp socket having brads in its base to puncture the insulation of conductors and a central screw by which the socket can be supported on any structure.

754,778. TROLLEY WHEEL RETAINER; James A. Kelpatrick, Niles, Ohio. App. filed Dec. 19, 1903. Details.

754,804. SPEED REGULATING MAGNETIC CLUTCH; Charles A. Pratt, Oakpark, Ill. App. filed Dec. 7, 1903. Two transmission disks mounted to rotate independently and having opposed spherical faces in which friction pulleys are located. By shifting the position of the pulleys, the difference in speed of rotation is obtained.



754,762.—Electric Socket Support.



754,804.—Speed Regulating Magnetic Clutch.

754,832. ELECTRIC RAILWAY PLOW; John H. Akers, Washington, D. C. App. filed Aug. 8, 1903. Details.

754,858. STORAGE-BATTERY TRAY; Thomas A. Edison, Llewellyn Park, N. J. App. filed Nov. 28, 1902. (See page 608.)

754,859. REVERSIBLE GALVANIC BATTERY; Thomas A. Edison, Llewellyn Park, N. J. App. filed Nov. 28, 1902. (See page 608.)

754,863. ELECTRICAL PLUG AND RECEPTACLE; Gilbert W. Goodridge, Bridgeport, Conn. App. filed Oct. 9, 1903. Details.

754,868. FIRE AND WATER-PROOF INSULATING COVERING FOR METALLIC SURFACES; John A. Heany, Philadelphia, Pa. App. filed May 10, 1902. An agglomeration of a gluey substance and asbestos.

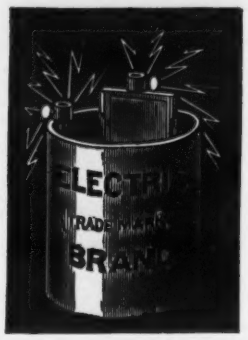
754,884. CABLE CLIP; James McFarlane, Allegheny, Pa. App. filed June 3, 1903. A strap having a hook at each end which passes over the wire in opposite directions.

754,885. AUTOMATIC FIRING DEVICE FOR ORDNANCE; Ludwig Obry, Triest, Austria-Hungary. App. filed Sept. 12, 1903. Details.

754,894. SELF-ADJUSTING WHEEL; Edgar A. Root and Charles M. Wallace, Huntington, W. Va. App. filed May 23, 1903. Details.

754,904. WIRELESS SIGNALING SYSTEM; Harry Shoemaker, Philadelphia, Pa. App. filed June 11, 1902. A freely oscillating circuit, an inductance winding included therewith and a radiating surface connected to the terminals of the winding.

754,935. RINGING AND LISTENING KEY; Charles H. North, Cleveland, O. App. filed Sept. 14, 1901. Details.



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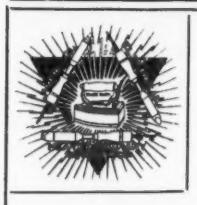

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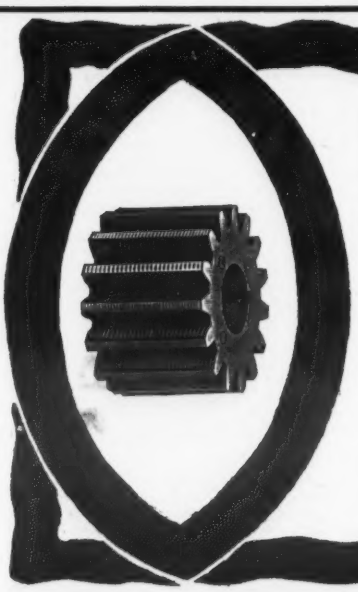

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(*Continued on page 47.*)

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1	600	West., 30-K.W., comp., single phase
1	750	Wood, 37½-K.W., comp., single phase
1	900	West., 45-K.W., comp., 2 phase.
1	1200	West., 60-K.W., single ph., comp.
1	1500	Warren-Medberry, 75-K.W., 2 ph., ind. type
1	1500	Stan., inductor, 75-K.W., 2 ph.
1	1500	West, 75-K.W., comp., distributed winding, 2 ph.
1	1500	West., 75-K.W., 2 ph., 2200 v., d. c. to 14x14 Gates 4-valve aut. engine
1	1500	Wood, 75-K.W., comp.
1	2400	Gen. Elec., 120-K.W., 3 phase, 2200 or 3300 v.
1	7200	Gen. Elec., 360-K.W., 3 phase, 2300 volts
1	3000	Westinghouse, single phase, 150-K.W., 2200 volts, latest type, direct connected to 12x24x14 Harrisburg tandem compound self-oiling engine, complete with exciter and switchboard panel, speed 257

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1	750	Wood, 37½-K.W., comp.
1	900	Warren-Medberry, 45-K.W., inductor type
1	1000	Wood, 50-K.W., comp.
2	1200	West., 60-K.W., toothed armt., comp.
1	1500	Wood, 75-K.W., comp.
1	1500	Stanley, inductor type, 75-K.W., 1100 or 2200 v., 2 phase.
1	2400	Gen. Elec., 120-K.W., type A 120, latest type, comp., toothed armt.
2	2400	Gen. Elec., 120-K.W., type A S, comp., slotted armt.
2	2400	West., 120-K.W., comp., self-oiler, toothed armt.
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110 TO 125 VOLT GENERATORS.

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Lt.		Speed.
6	10	Towle, M. P., compound 2000
2	12	Edison, self-oiler 2700
1	15	Wagner, 15 amp., M.P. 50 v. 1800
1	30	General Electric, type C A 2100
2	35	Hobart, M. P., comp. 1600
1	40	Roth, M. P., comp., direct connected to Drake engine 800
1	45	Lundell 1800
3	45	Westinghouse, M. P., comp 1800
1	50	Crocker-Wheeler, self-oiler 1150
2	50	Northern, M. P., compound 2050
1	50	Westinghouse, M. P., comp. 1150
2	60	Hobart, M. P., comp., s-o. 1200
1	75	Westinghouse, M. P., comp. 1600
1	75	Phoenix, comp., direct connected to No. 4 Case engine 650
1	80	Fort Wayne, multipolar 1600
1	80	Crocker-Wheeler 1000
1	80	Riker, M. P., comp., s-o. 1100
1	80	Perrett, multipolar 950
1	100	Triumph, M. P., comp. 1250
1	100	Card, M. P. 1000
2	110	Commercial, M. P., comp. 1600
1	150	Edison, comp. 1700
1	150	Eddy, M. P. 1650
1	150	Western Elec., M. P. 1600
1	150	General Electric, M. P. 1400
1	160	Triumph, M. P., compound 1200
1	160	Northern, M. P., compound 900
1	165	Am. Engine Co., M. P. 1400
1	210	Edison, self-oiler, 12-K.W. 1600
1	210	Phoenix, M. P., comp. 1650
1	210	Eddy, M. P. 1100
1	225	Card, M. P., comp. 690
1	260	Commercial, M. P., comp. 1100
1	300	Phoenix, M. P. 1100
1	300	Perrett, M. P., comp. 750
1	300	Ahlms-Edwards, M. P., comp. 825
2	300	Gen. Electric, M. P., comp. 1100
1	300	Western Elec., M. P., comp. 750
2	350	Edison, 20-K.W., comp., s-o. 1400
2	350	C. & C., M. P. 800
1	350	Card, M. P., enclosed 800
1	400	Northern, 22½-K.W., M. P., comp. 1000
1	400	Crocker-Wheeler, M.P, comp. 875
2	400	Westinghouse, M. P., comp. 975
2	450	Edison, 25-K.W., self-oiler 1300
2	450	Commercial, M. P., comp. 1000
1	450	Quaker City, M. P., comp. 1000
1	450	Triumph, M. P., comp. 750
2	450	Sprague-Lundell, M. P., comp 875
1	450	Eddy, M. P., comp. 950
1	450	Gen. Electric, M. P., comp. 1050
1	450	Western Elec., M. P., comp. 650
1	540	Edison, comp., 30-K.W. 1200
1	540	C. & C., M. P., 30-K.W. 700
1	540	Elwell-Parker, M. P., comp. 600
2	540	Gen. Elec., M. P., comp. 30-K.W. 1000
3	600	Card, M. P., compound 750
1	650	Milwaukee, M. P., comp. 650
1	650	Westinghouse, M. P., comp. 900
1	650	Westinghouse, M. P., 35-K.W., engine type, direct connected to 10x10 enclosed self-oiling Buffalo Forge engine, class A, upright 350
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1	700	Card, M. P., compound 750
1	700	Crocker-Wheeler, M. P., comp. 1085
1	900	Wagner, M. P., comp., 50-K.W. 950
1	1000	Edison, s-o., 60-K.W., comp. 700
1	1000	Gen. Elec., 6 pole, comp., direct connected to 12x13 Weston automatic engine, 60-K.W. 275
1	1100	Triumph, M. P., comp., 65-K.W. 850
1	1300	Card, M. P., comp., 75-K.W. 500
1	1350	Waddel-Entz, 80-K.W., d. c. to Armington & Sims 15½x14 engine 265
1	1350	Ft. Wayne, comp., direct connected to 13x14 Buckeye vertical engine, 80-K.W. 275
2	130	Gen. Elec., M. P., 6 pole shunt, direct connected to Ames tandem comp. 11x17x12 automatic engine 270
2	1800	Edison, 100-K.W., s-o., comp. 650
1	1800	Western Electric, M. P., comp., 6 pole, 100-K.W. 425
1	2200	Western Electric, M. P., 125-K.W., latest type, comp., 6 pole, 3 bearing. (Above machine can be arranged for direct connection also.) 225
2	2500	Western Electric, M. P., comp., 150-K.W., direct connected to 16x18 McEwen engine 240

220 TO 250 VOLT GENERATORS.

K.W.		Speed.
1	7½	Holtzer-Cabot, compound 1350
1	9	New England, M. P. 1600
2	10	T.-H., D 10, oil cups 1600
1	12	Western Elec., M. P., comp. 750
1	15	Edison, self-oiler 1500
1	17½	Kester, comp. 1350
1	17½	Eddy, type C, comp. 1450
1	20	Edison, self-oiler, comp. 1400
1	20	Western Electric, comp., s-o. 700
1	20	Keystone, M. P., comp. 950
1	20	Eddy, M. P., comp. 825
1	20	Western Elec., M. P., comp. 650
2	30	C. & C., comp., self-oilers 800
1	40	C. & C., multipolar, comp. 750
1	40	Eddy, M. P., comp. 875
1	40	Commercial, M. P., d. c. to 11x12 automatic Chandler-Taylor engine 300
1	45	Edison, comp., self-oiler 1000
1	45	Am. Engine Co., M. P., comp. 700
1	45	Western Elec., M. P., comp. 550
1	45	C. & C., M. P., comp. 700
1	45	Gen. Elec., M. P., comp. 925
1	50	C. & C., compound 800
1	50	Commercial, M. P., comp. 775
1	50	Maine, M. P., compound 600
1	55	Fuller, multipolar, comp. 750
1	55	Eddy, M. P., comp. 750
1	60	Sprague, compound 500
1	60	Northern, M. P., comp. 800
1	75	Siemens & Halske, Churchward type, M. P., direct connected to 14x14 Ideal engine 300
1	80	C. & C., comp., self-oiler 625
1	100	Edison, comp., self-oiler 650
1	100	Commercial, M. P., comp. 675
1	125	Eddy, M. P., comp. 700
2	150	National, M. P., comp. 350
1	200	Eddy, multipolar, compound 500
1	250	Western Electric, 6 pole, type L, 3 bearing, compound 450
1	300	Western Electric, M. P., brand new 480

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2—500-K.W. Westinghouse, 4 pole.
2—300-K.W. General Electric, 4 pole.
1—300-K.W. Westinghouse, 6 pole.
1—200-K.W. General Electric, 4 pole.
1—200-K.W. Edison bipolar.
2—175-K.W. Edison bipolar.
1—150-K.W. Westinghouse, 4 pole.
1—110-K.W. General Electric, 6 pole.
2—100-K.W. General Electric, 4 pole.
2—100-K.W. Edison bipolar.
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Complete stock of motors.

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1—120-K.W. C. & C., 6 pole.
1—100-K.W. C. & C., 6 pole.
1— 50-K.W. Bullock, 4 pole.
1— 40-K.W. Crocker-Wheeler, 4 pole.
1— 16-K.W. Ft. Wayne, 4 pole.
1— 12-K.W. Keystone, 4 pole.
Complete stock of motors.

110-125 VOLT GENERATORS AND MOTORS

2—45-K.W. Westinghouse, 4 pole.
2—60-K.W. Edison bipolar.
1—40-K.W. C. & C., 4 pole.
1—35-K.W. Loomis, 6 pole.
1—35-K.W. Mather, 4 pole.
1—21-K.W. Riker, 4 pole.
1—17½-K.W. General Electric, 4 pole.
1—15-K.W. Edison bipolar.
1—12½-K.W. Card, 4 pole.
2—3-K.W. Westinghouse bipolar.
Complete stock of motors.

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2—50-K.W. American Ball, 220 volts, D. C. duplex and simple engines.
2—42-K.W. Westinghouse D. C. Alfrey engines.
30-K.W. Eddy, 125 volts. D. C. Watertown engine.
25-K.W. Westinghouse, 125 volt, D. C. Westinghouse.
7½-K.W. Northern, 125 volt, D. C. Hill Vertical Engine (new).
6-K.W. ditto.
4-K.W. ditto.
3-K.W. ditto.

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250-K.W. Westinghouse, 60 cy., 2 ph., 2,200 volts.
100-K.W. G. E., 60 cy., 3 ph., 2,300 v.
65-K.W. Stanley, 60 cy., 2 ph.
20-H.P. Westinghouse, 2 ph., 60 cy.
3-H.P. Westinghouse, 2 ph., 60 cy.
2-H.P. G. E., 3 ph., 60 cycle.

ALTERNATING (125 Cycle)

120-K.W. G. E., s. ph., 1,100 v.
120-K.W. Westinghouse, 2,200 v.
100-K.W. G. E., s. ph., monocyclic.
2—A-70 T. H., s. ph., 1,100 v.
1—60-K.W G. E., s. ph., 1,100 v.
2—35-K.W. Westinghouse, 1,100 v.
10-H.P. Excelsior, s. ph., 125 cycle.

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3—11 and 17x24 Harrisburg tandem.
1—16 and 30x48 Hamilton Corliss.
1—17x42 Brown of Fitchburg.
1—14x28 Delamater Corliss.
1—13x21 Buckeye tangye bed (130 H.P.).
1—13x14 McIntosh & Seymour.
2—13x12 Erie Ball automatic (with subbases).
2—9½x10½ McIntosh & Seymour.
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15-K.W. Eddy, M. P.
10-K.W. Eddy, M. P.
5-K.W. C. & C.
3-K.W. C. & C.
2-K.W. Lundell.
1-K.W. C. & C.

500 VOLTS DIRECT CURRENT
Dynamos or Motors

15-H.P. General Elec., M. P.
7½-H.P. General Elec., M. P.
5-H.P. Sprague.
2-H.P. General Elec.

220 VOLTS DIRECT DURRENT
Dynamos or Motors

40-H.P. Sprague, M. P.
25-H.P. Crocker-Wheeler, M. P.
20-H.P. Card.
15-H.P. Sprague, M. P.
10-H.P. General Elec.
10-H.P. Holtzer Cabot.
7½-H.P. Card.
7½-H.P. Edison.
7½-H.P. C. & C.
5-H.P. Paragon, M. P.
5-H.P. Holtzer Cabot.
5-H.P. Crocker-Wheeler.
3-H.P. Diehl.
3-H.P. C. & C.
2-H.P. General Elec.
2-H.P. Diehl.
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15-H.P. Type C Westinghouse.
10-H.P. Type C Westinghouse.
7½-H.P. Type C Westinghouse.
5-H.P. Type C Westinghouse.
2-H.P. General Elec.
1-H.P. Westinghouse.
½-H.P. General Elec., 220 or 110 v.
¼-H.P. General Elec.

2 Phase, 440 Volts, 60 Cycles

30-H.P. Westinghouse.
15-H.P. Westinghouse.
10-H.P. Westinghouse.
7½-H.P. Westinghouse.
5-H.P. Westinghouse.
3-H.P. Westinghouse.
1-H.P. Westinghouse.

3 Phase, 60 Cycles

5-H.P. Westinghouse, 220 volts.
2-H.P. Gen. Elec., 110 volts.
2-H.P. Westinghouse, 220 volts.
½-H.P. General Elec., 220 volts.
½-H.P. General Elec., 110 volts.

1 Phase, 60 Cycles

7-H.P. Wagner, latest type.
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Large stock of small motors, autostarters, starting boxes, rheostats, switchboards, voltmeters, ammeters, etc.

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ELECTRIC LOCOMOTIVES.

	Ton.	
1	10	Morgan-Gardner, type M, 250 v., direct current, double motor locomotive, 74-K.W., 42-inch gauge, speed 6 to 10 miles per hour
1	17	Morgan-Gardner, type N, 250 v., direct current, double motor locomotive, 115-K.W., 40-in. gauge, speed 8 miles per hour

500 TO 550 VOLT GENERATORS.

	K.W.		Speed.
1	60	Edison, comp., self-oiler, new armt. and commutator	800
1	62	T.-H., D 62, s-o., comp.	900
1	75	Akron, M. P., 6 pole	900
1	75	Bullock, multipolar	900
2	75	General Electric, M. P. 4, comp., new rewound	700
1	100	Siemens & Halske, 4 pole, with bar-wound armature, compound	600
2	100	Edison, compound	650
1	100	Gen. Elec., M. P. 4, comp.	650
1		General Electric slate panel switchboard for above, complete with ammeter, circuit breaker and resetting device, main line switch, rheostat switch, bus-bar connections, etc.	
2	120	Westinghouse, M. P., comp.	625
1	200	Thompson-Ryan, M. P., comp., three bearings	525
1	200	General Electric, M. P. 4, comp., s-o., 3 bearings, new commutator	400

ARC DYNAMOS.

	Lt.	C.P.		Speed.
1	35	2000	T.-H., L D 2 ball	820
1	45	1200	Brush, No. 7	1050
1	50	1200	T.-H., L D 12, new ball	820
2	50	2000	T.-H., M. D 2, s-o., ring	820
1	65	2000	Brush, No. 8	950
1	75	1200	T.-H., M D 12, s-o.,	820
1	75	1200	Wood	950
1	100	2000	Wood	600
1	125	1200	Brush, 6.6 amp.	700
2	125	2000	Brush, 9.6 amp.	500
1	125	1200	Excelsior	700

220 TO 250 VOLT MOTORS.

	H.P.	DIRECT CURRENT.	Speed.
1	1	General Electric, type I B	1025
1	1⅛	Commercial, self-oiler	1200
1	2	Lundell, newly rewound	1000
1	2½	Riker, s-o., with extra armt.	1460
1	3	C. & C.	1400
1	3	Bernard, M. P.	1525
1	3	Gibbs, M. P.	1400
1	3	Lundell, self-oiler	1500

BARGAINS IN (second-hand) ELECTRICAL MACHINERY

We do not offer old, worn out machines fit for the Junk pile, but the LATEST TYPES of the leading manufacturers.

GREGORY ELECTRIC CO.

54-62 S. CLINTON ST. CHICAGO.

Send for our Monthly Bargain Sheet showing NET prices—all machines fully guaranteed.

2	1	General Electric, 110 volts	1800
3	3	Western Electric, M. P.	1000
3	3	Westinghouse, M. P.	1700
1	3	Storey, variable speed	300-1500
1	3½	Eddy, M. P.	400
1	4	Commercial, M. P.	450
2	5	Gibbs, M. P.	1400
3	5	Hobart, M. P.	1050
5	5	Western Electric, M. P.	950
1	5	Eddy, M. P.	300
3	5	Belknap, M. P.	230
2	5	Crocker-Wheeler special printing press motors, direct con.	318
1	6½	Jenny, M. P., back geared, speed of shaft	440
1	7½	Waddell-Entz, M. P.	900
1	7½	Edison	1350
1	7½	Towle, M. P.	1600
1	7½	Western Electric, M. P.	1150
2	7½	Western Electric, M. P.	950
1	7½	Milwaukee, M. P., series, crane type, grease cup	600
1	8	Holtzer-Cabot	1250
1	8	Crocker-Wheeler, series, crane type	900
1	8	Maine, M. P.	200
1	10	Standard, M. P.	670
1	10	C. & C., M. P., enclosed	1100
1	10	Keystone, M. P., enclosed	1175
1	10	Western Electric, M. P.	800
1	10	Story, M. P., enclosed	600
2	10	Westinghouse, M. P.	1250
3	10	Bernard, M. P.	130
1	12	C. & C., self-oiler	1100
1	15	Keystone, M. P.	1570
1	15	New England, M. P., 8 pole	650
1	15	Western Electric, M. P	625
1	18	Edison, 15 K.W.	1150
1	20	Eddy	1300
1	20	Kester	1250
2	25	Edison, self-oilers	1100
1	25	Western Electric	525
1	25	Keystone, M. P.	850

	H.P.		Speed.
1	25	Eddy, M. P.	725
1	25	Western Electric, M. P.	550
2	40	C. & C., self-oilers	650
1	40	Sprague-Lundell, M. P.	625
1	50	C. & C. multipolar	650
1	50	Eddy, M. P.	675
1	50	Am. Engine Co., M. P.	565
1	60	C. & C., self-oiler	600
1	60	Edison, self-oiler	750
1	60	Commercial, M. P.	600
1	60	C. & C., M. P.	560
1	60	Maine, M. P.	500
1	60	Western Electric, M. P.	425
1	60	General Electric, M. P.	800
1	65	Eddy, M. P.	650
1	70	Fuller, multipolar	600
1	75	Sprague, self-oiler	450
1	75	Northern, M. P.	700
1	85	Western Electric, self-oiler	500
1	100	C. & C., self-oiler	450
1	125	Edison, self-oiler	550
1	135	Commercial, M. P.	675
1	150	Eddy, M. P.	600
2	200	National, M. P.	300

500 TO 550 VOLT MOTORS.

	H.P.		Speed.
1	1	General Electric, C. A.	1200
1	1½	Belknap, self-oiler	1700
2	1½	Northern, series	1400
2	1½	Crocker-Wheeler	1550
1	2	Maine, M. P.	1100
1	2½	Bain, self-oiler	2100
1	2½	New England	1500
1	3	C. & C., self-oiler	1600
1	3	General Electric, type C E	1800
1	3	Maine, M. P.	1100
1	3	Jenney, M. P., back geared, speed of shaft	240
1	3½	Roth	1700
1	3½	Roth, M. P.	950
1	3½	Westinghouse, M. P.	1050

	H.P.		Speed.
1	4	Edison, 3 K.W.	1700
4	4	Maine, multipolar	550
1	4	Bernard, M. P.	550
1	5	Hobart, self-oiler	1600
1	5	Fort Wayne	1400
2	5	Triumph, M. P.	1250
3	5	Crocker-Wheeler	950
1	6	C. & C., enclosed	1030
2	6	T.-H., D 5, self-oilers	1800
2	7½	Thomson-Houston, D 7½	1600
1	7½	Roth, self-oiler	1400
1	7½	Card, multipolar	775
1	7½	Jenney, M. P.	1500
1	7½	C. & C., M. P., compound	1160
3	7½	Crocker-Wheeler	1500
1	7½	Eddy, M. P.	875
1	10	Phoenix, M. P.	950
1	10	Crocker-Wheeler	1275
1	10	Northern, M. P.	1350
1	10	Triumph, M. P.	1100
2	10	General Electric, M. P.	1400
1	10	Perrett, M. P., compound	600
1	10	Eddy, M. P.	650
3	10	Belknap, M. P.	500
1	12	Am. Engine Co., M. P.	1365
1	15	Eddy, self-oiler	1725
1	15	C. & C., self-oiler	975
1	15	Edison	1275
1	15	Perrett, M. P.	1100
1	15	Maine, M. P.	450
1	20	Eddy, self-oiler	1500
1	20	Perrett, M. P.	700
1	20	Holtzer-Cabot, M.P., enclosed	1150

ALTERNATING CURRENT MOTORS.

SINGLE PHASE. 125-133 CYCLES.

	H.P.		Speed.
10	½	Stanley, 100-110 volts, new	2400
1	½	Holtzer-Cabot, 104 volts	2500
1	½	Emerson, 104 volts	2000
1	½	Wagner, 104 volts, aut.	2000
1	1	Fort Wayne, 104 volts	2500
1	1	Wagner, 208 volts, aut.	2000
1	1½	Wagner, 208 volts, aut.	2000
1	3½	Wagner, 110 volts, automatic	1875

THREE PHASE. 125-133 CYCLES.
For Monocyclic System.

	H.P.		Speed.
1	3	General Electric, 110 volts	1875

SINGLE PHASE. 60 CYCLES.

	H.P.		Speed.
2	½	Phillips, 104 volts	1800
1	½	General Electric, type I S, 110 v., with type K. S. condenser-compensator, new	1800
1	¾	Gen. Elec., type I. S., form L	1800
1	1	Phillips, 208 volts	1600
1	1	Phillips, 104 volts	1600
1	2	Wagner, 500 volts, aut.	1800
1	2	Wagner, 104 volts	1800
1	15	Wagner, 104 volts, aut.	1200
2	30	Wagner, 184 volts, automatic	1200

For Sale:—Four 22' and 42' x 48'

Hamilton Tandem Compound Condensing Corliss Engines

With Independent Condenser for Each. Wheels: 24 ft. x 50 ins. 60,000 lbs. Capacity: 750 to 1,000 H. P. Each. Located in New York City.

900-H.P. 34x60 International Power Corliss.
450-H.P. 16 and 30x42 Allis Compound Corliss.
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300-H.P. 20x48 Harris Corliss.
275-H.P. 20x42 Hamilton Corliss Engine.
225-H.P. 18x42 Hamilton Corliss.
200-H.P. 18x36 Bates Corliss.
200-H.P. 12 and 22x42 Atlas Compound Corliss.
175-H.P. 16x42 Allis Corliss.
150-H.P. 15x38 Brown Corliss.
125-H.P. 14x36 Putnam Corliss.
100-H.P. 12x36 Harris Corliss.
85-H.P. 12x30 Lane and Bodley Corliss.
650-H.P. 28½x52 Buckeye Automatic.
450-H.P. 24x48 Buckeye Automatic.
400-H.P. 16½ and 28½x27 Buckeye Compound Automatic.
250-H.P. 16 and 27x16 Westinghouse Compound.
100-H.P. 13x12 Ideal S. O. Automatic.
90-H.P. 12x20 Atlas Side Crank Automatic.
90-H.P. 12x16 Erie Center Crank Aut.
40-H.P. 9x13 Frost Side Crank Automatic.

BOILERS

1—350-H.P. Babcock and Wilcox Boiler, 150 lbs.
1—280-H.P. Babcock and Wilcox Boiler, 150 lbs.
2—265-H.P. Babcock and Wilcox Boilers, 150 lbs.
3—265-H.P. Babcock and Wilcox Boilers, 135 lbs.
1—175-H.P. Babcock and Wilcox Boiler, 125 lbs.
1—172-H.P. Babcock and Wilcox Boiler, 130 lbs.
1—250-H.P. Cahall Vertical Boiler, 162 lbs.
14—72x22 Tubular Boilers, 115 lbs.
7—72x18 Tubular Boilers, 120 lbs.
7—72x18 Tubular Boilers, 100 lbs.
3—72x16 Tubular Boilers, 100 lbs.
8—66x18 Tubular Boilers, 100 lbs.
3—66x16 Tubular Boilers, 100 lbs.
1—60x18 Tubular Boiler, 100 lbs.
4—60x16 Tubular Boilers, 100 lbs.
2—60x14 Tubular Boilers, 120 lbs.
Cookson Heaters, 50, 75, 100, 150 and 200 H.P.

WHITEHEAD MACHINERY CO., Davenport, Iowa.
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DIRECT CONNECTED.

30-K.W. Eddy dynamo to Watertown engine, 110 volts.
10-K.W. Westinghouse dynamo to Armington & Sims engine, 110 volts.
10-K.W. Westinghouse dynamo to Westinghouse engine, 110 volts.
80-Amp. Edison dynamo to Brotherhood engine, 80 volts.
20-H.P. Elektron 220 volt motor to Morse Williams freight elevator.

BELTED.

60-amp. Crocker-Wheeler to Herresoff engine, 110 volts.
2000 volt Electro Dynamic arc dynamo, 10 amperes.
500-Lt. Edison dynamo, 110 volts.
60-amp. Westinghouse dynamo to Westinghouse engine, 110 volts.
35-amp. Sprague dynamo to Hornby Ackroyd oil engine.
600-Lt. Weston dynamo, 110 volts.
500-Lt. Edison Dynamo, 110 volts, D.C. to Brotherhood engine.
400-Lt. Excelsior dynamo, 110 volts.
45-H.P. C. & C. motor, 230 volts.
30-H.P. C. & C. motor, 230 volts.
15-H.P. Thomson-Houston motor, 500 volts, with spare armature.
15 General Electric, 2-H.P., 220 volt motors.
12 Siemens & Halske 5-H.P., 220 volt motors, 220 volts, 1550 R.P.M.
2 search lights.
These motors are dust proof and series wound.
Large stock of smaller dynamos and motors.
Repairing of electrical machinery in all its branches.

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METER ENGINEER

with broad central station and factory experience, and technical training desires position with central station. Can overhaul and handle systems of any size and put them on an engineering basis. Address W. S. J., care Electrical World and Engineer, 1139 Monadnock, Chicago.

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A 150 K.W. 500 volt, direct current, moderate speed generator.

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1—180-K.W. General Electric Alternator, two-phase, 60-cycle.
2—180-K.W. General Electric Alternators, single-phase, 60-cycle.
1—120-K.W. Westinghouse Alternator, two-phase, 60-cycle.
1—120-K.W. General Electric Alternator, single-phase, 60-cycle.
1—360-K.W. Stanley Alternator, two-phase, 133-cycle.
2—150-K.W. Wood Alternators, 133-cycle, 3-bearing.
1—100-K.W. Western Electric, 6-pole, 115-V. Generator, direct connected to 16x16 latest type Ideal Automatic Engine.
1—75-K.W. Western Electric, 6-pole, 220-V.
1—200-K.W. Westinghouse Railway Generator.

ENGINES.

1—Brand new 18x16 American Ball Automatic Engine, ready to ship.
1—16 & 30x48 Cooper Cross-compound Condensing Corliss Engine, with Condenser.
1—24x48 Hamilton Corliss, Double Eccentric.
1—22x48 Allis Corliss.
1—18¾x36 Buckeye, Class A.

BOILERS.

2—250-H.P. B. & W. Water-Tube Boilers.
1—72x18 Horizontal Tubular Boiler.
Write for list No. 42 of Dynamos, Engines and Boilers.

STATION EQUIPMENT COMPANY, 204 DEARBORN ST., CHICAGO.

CORRECT INSULATING PAINTS VARNISHES COMPOUNDS

(3) DIELECTRIC MFG. CO., SAINT LOUIS

Dynamo and Motor Repairing

Armature Winding, Armature Coils. Commutators, Gears and Pinions.

Our Specialty **Railway Field Coils** of Every Type

The ELLIOTT BROS. ELECTRIC CO.
Cleveland, O.

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(with or without real estate) no matter where it is or what it is worth. Send description, state price, and learn how. I have a special department for buying and selling electric light and gas plants. If you want to buy, tell me your requirements. W. M. OSTRANDER, 196 North American Building, Philadelphia.

ARE YOU SATISFIED

with your present position and salary? If not, write us for plan and booklet. We have openings for Managers, Secretaries, Advertising Men, Salesmen, Bookkeepers, etc., paying from $1,000 to $10,000 a year. High grade exclusively.

HAPGOODS (Inc.) (2)
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FOR SALE

A new up to date electric light plant; can show 12 per cent. to 14 per cent. on investment; exclusive city franchise; have city lighting. Address No. 1369, care Electrical World and Engineer, New York.

FOR SALE OR TRADE.

35-H.P. 230-volt Western Electric motor, $225.00
2-H.P. 500-volt T. H. motor, $45.00.
75 light, 110-volt Westinghouse dynamo, $70.00.
125 light, M. P., Ruprecht, 110 volts, $90.00.
3-H.P. Mather, 500 volts, $40.00.

The Standard Machinery & Equipment Co.
410 Electric Building, Cleveland, Ohio.

If you want to do business with any man in the electrical field in any part of the world the right medium to advertise in is ELECTRICAL WORLD AND ENGINEER.

WANTED.

One copy each of ELECTRICAL WORLD AND ENGINEER, dated July 29, 1899; July 12, 1902; July 11, 1903.

One copy each of AMERICAN ELECTRICIAN, for January and February, 1900, and for July, August, September and October, 1902.

Copies must be clean and well preserved; will pay face value. Address No. 1372, care Electrical World and Engineer, New York.

North, South, East, West, at home and abroad . . . . **Electrical World and Engineer** is recognized as the leading electrical journal, and is therefore the one which is consulted when purchasing is to be done.

IT HAS NO GEOGRAPHICAL LIMITATIONS.

PROPOSALS

In virtue of a resolution of the Municipal Council of San Luis Potosi, approved by the superior Government of the State, contractors for electric lighting are invited to present their propositions for the public illumination of this city, with the understanding that the contract that may be made shall be based upon the following clauses:

I. The contractor by himself, or through the company or companies he may organize, shall establish in this city an Electrical Plant according to the latest and most adequate system in the opinion of such experts as the commission of this department shall duly appoint.

II. He shall be bound to establish by the last day of the present year the service of the illumination with a number of arc lights which shall not be less than one hundred and fifty, distributed according to the plan which shall be given him by the commission of illumination, who shall have the power to modify this distribution whenever it should be necessary within a reasonable term determined by same.

III. These lights shall illuminate daily from the setting of the sun until its rising on the following day.

IV. The contract shall be made for no less than fifteen years, and shall not be rescindable, except in the cases provided for by the law or by mutual consent between the contracting parties.

V. The price per light or for all the lights contracted for, shall be paid by the Municipal Council at the end of each month.

VI. The enterprise that shall have the preference shall make use of the streets, squares and other public places for their conductors, etc., in accordance with the respective commissions taking in consideration the concessions granted previously. Their plant shall be established outside of the perimeter marked out by the respective commissions.

VII. Said enterprise, within a month after the acceptance of their propositions, shall guarantee the fulfilment of their obligations by making a deposit of five thousand pesos in favor and to the satisfaction of the Municipal Council.

VIII. In said propositions mention must be made of the systems adopted for the lighting and installations, the power of each light and apparatus to show same, the price asked for, and, in short, all the details of the business.

IX. Upon making the agreement, details shall be also given as to the terms to be adopted, the capital to be paid out, the streets and other public places that may be used and penalties for the contracting parties, etc., etc.

X. This convocation shall be closed on the fifteenth of May of the present year and shall be published in the Republic as well as in the United States and in Europe.

SAN LUIS POTOSI, Mexico, Feb., 1904.
(Signed) ENRIQUE MILÁN, Sec'y.

For Sale. DIRECT CONNECTED APPARATUS

Direct Connected Direct Current
125 TO 250 VOLTS

1—425-K.W. unit consisting of two 210-K.W. 140-volt MP engine type General Electric generators, 120 R.P.M., direct connected to one 24 x36 Wright Corliss engine, for use on 125 or 250-volt circuit.

1—160-K.W. unit consisting of two 80-K.W. engine type MP 6 80-230 R.P.M. General Electric generators mounted on one base and direct connected to one 15 and 25x 16 horizontal tandem compound automatic Ball engine, 125 to 250 volts Edison three-wire system.

1—150-K.W. 110-volt MP 6 engine type General Electric generator direct connected to one 14 and 21x36 Penna. Iron Works tandem compound Corliss engine, 102 R.P.M.

2—150-K.W. 125-volt MP 8 150-225 R.P.M. latest type vertical split frame Westinghouse generators direct connected to two 18x16 simple horizontal 4-valve Corliss type steam jacketed cylinder Ball & Wood engines. These outfits are brand new. Immediate delivery.

1—125-K.W. 125-volt MP Siemans-Halske generator direct connected to simple engine.

1—75-K.W. 125-volt MP 6 engine type General Electric generator, 270 R.P.M., direct connected to one 14 x14 Ideal horizontal centre crank, high speed, automatic engine.

1—75-K.W. 125-volt MP 6, latest engine type Westinghouse generator, 275 R.P.M., direct connected to one 13x12 Ball & Wood centre crank, high speed automatic, simple engine.

1—60-K.W. 125-volt MP 6 60-280 R.P.M. engine type General Electric generator, direct connected to 12x12 Armington & Sims horizontal, centre crank, high speed, automatic engine, with new type governor.

1—62½-K.W. 250-volt MP 6 engine type Bullock generator, 275 R.P.M., direct connected to 14x12 Ames horizontal, centre crank, high speed, automatic engine.

1—50-K.W. 125-volt MP engine type G.I. generator, 300 R.P.M., direct connected to one 12x12 horizontal high speed Russell engine, with Rites governor. Brand new.

2—42-K.W. 125-volt engine type Westinghouse MP generators, direct connected to two 12x12 horizontal, high speed Alfree engines.

1—30-K.W. unit consisting of two 25-K.W. MP 6 engine type General Electric, 305 R.P.M., direct connected to one 11x12 simple horizontal, high speed Ball engine, for use on Edison 3-wire 125 or 250-volt circuit.

1—30-K.W. 125-volt engine type Westinghouse generator, 300 R.P.M., direct connected to one 11x10 simple, horizontal, automatic high speed Ball engine.

IMMEDIATE SHIPMENT
IN STOCK Jersey City and St. Louis Factories

1—25-K.W. MP 6 125-volt engine type General Electric generator, 360 R.P.M., direct connected to 8 and 13x8 Westinghouse vertical compound engine.

1—20-K.W. 125-volt MP 4 engine type Triumph generator, 350 R.P.M., direct connected to one 8x10 horizontal, high speed, automatic Chandler & Taylor engine.

1—12½-K.W. 125-volt Sprague Lundell type generator, 280 R.P.M., direct connected to one 20-H.P. two-cylinder National Meter Company's gas engine. This outfit is practically new.

1—10-K.W. 125-volt MP engine type Eddy generator, 400 R.P.M., direct connected to Wm. Bagley & Sons vertical, automatic, high speed engine.

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BRANCH OFFICES: Missouri Trust Building, St. Louis, Mo

(*Continued from page 44.*)

POSITION WANTED.—Electrical engineer, technically educated; experienced with one of largest electrical manufactors in shops, testing rooms, road construction, laying out of all kinds of plants, switchboards and wiring and estimating of same; familiar with standard practices; specialty of switchboard engineering. Address No. 1382, care Electrical World and Engineer.

POSITION WANTED.—Engineer, college graduate in Electrical and Mechanical Engineering, 5 years' practical experience machine shops and drawing office; 12 years' experience in the operation of electric light and power and mill plants at home and abroad; wishes position as superintendent or assistant; age 38; disengaged March 31. Address No. 1374, care Electrical World and Engineer, New York.

POSITION WANTED.—By young man superintendent electric light and power company of 300 h.p.; graduate electrical engineer from International Correspondence Schools; age 23, unmarried; desires to change his situation for one as electrician for manufacturing company or superintendent of electric light company in another location. Address No. 1383, care Electrical World and Engineer, New York.

POSITION WANTED.—As manager or superintendent of lighting and power plants; fifteen years' experience as manager and superintendent of the above systems; twelve years with present company; best of references; merger of companies reason for change. Address No. 1387, care Electrical World and Engineer, New York.

POSITION WANTED by an electrical engineer, for past 4 years with New York Edison Company in responsible position; references covering 8 years' experience in designing and constructing electric light and power plants; up-to-date on alternating-current transmission and conversion systems. Address No. 1386, care Electrical World and Engineer, New York.

POSITION WANTED.—As manager or superintendent of independent telephone company; 5 years' experience in construction work; can handle men; married man; best of references. Address No. 1388, care Electrical World and Engineer, New York.

POSITION WANTED.—By American young man, 20; good personality, mechanical inclination, A-1 habits and home surroundings with parents; selects electrical business with future as life's calling; solicits trial situation on his merits with large contracting concern or others; security, endorsement. Address No. 1375, care Electrical World and Engineer, New York.

POSITION WANTED.—As superintendent or foreman on electrical construction; thoroughly understand installation of apparatus, switchboards, cable and line work including 50,000 volt work; eleven years' practical experience; prefer position with large water power, high tension transmission company; best references. Address D., 88 Glenwood Ave., Buffalo, N. Y.

HELP WANTED.

WANTED.—Three experienced incandescent lamp salesmen, by an old and well established company not in the Trust; applicants will please state age, experience and salary wanted. Address No. 835, care Electrical World and Engineer, New York.

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WANTED

By a concern now making switchboards, panel boards and knife switches and having a good connection in Canada and a well equipped shop, lines of electrical goods to manufacture for the Canadian market; an oil circuit breaker is particularly desired. Address No. 1379, care Electrical World and Engineer, New York.

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Electric Light machinery consisting of 400 horsepower in boilers, engines, pumps, dynamos, switchboards, etc., complete; will be sold as a whole or in lots as desired; complete detailed description on application. Address

PHŒNIX LIGHT & FUEL CO.,
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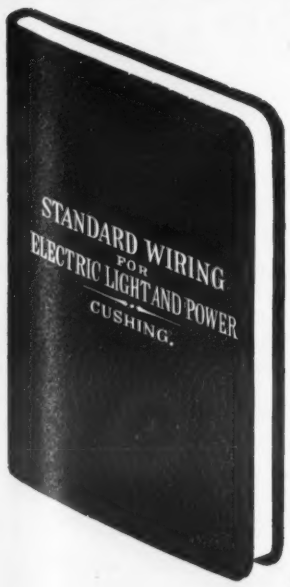

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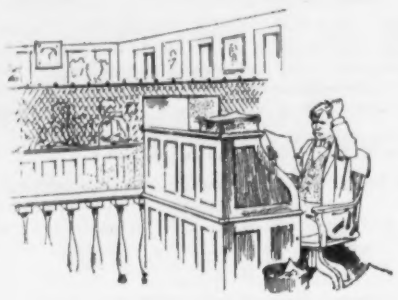

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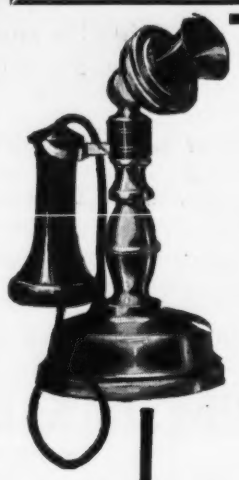

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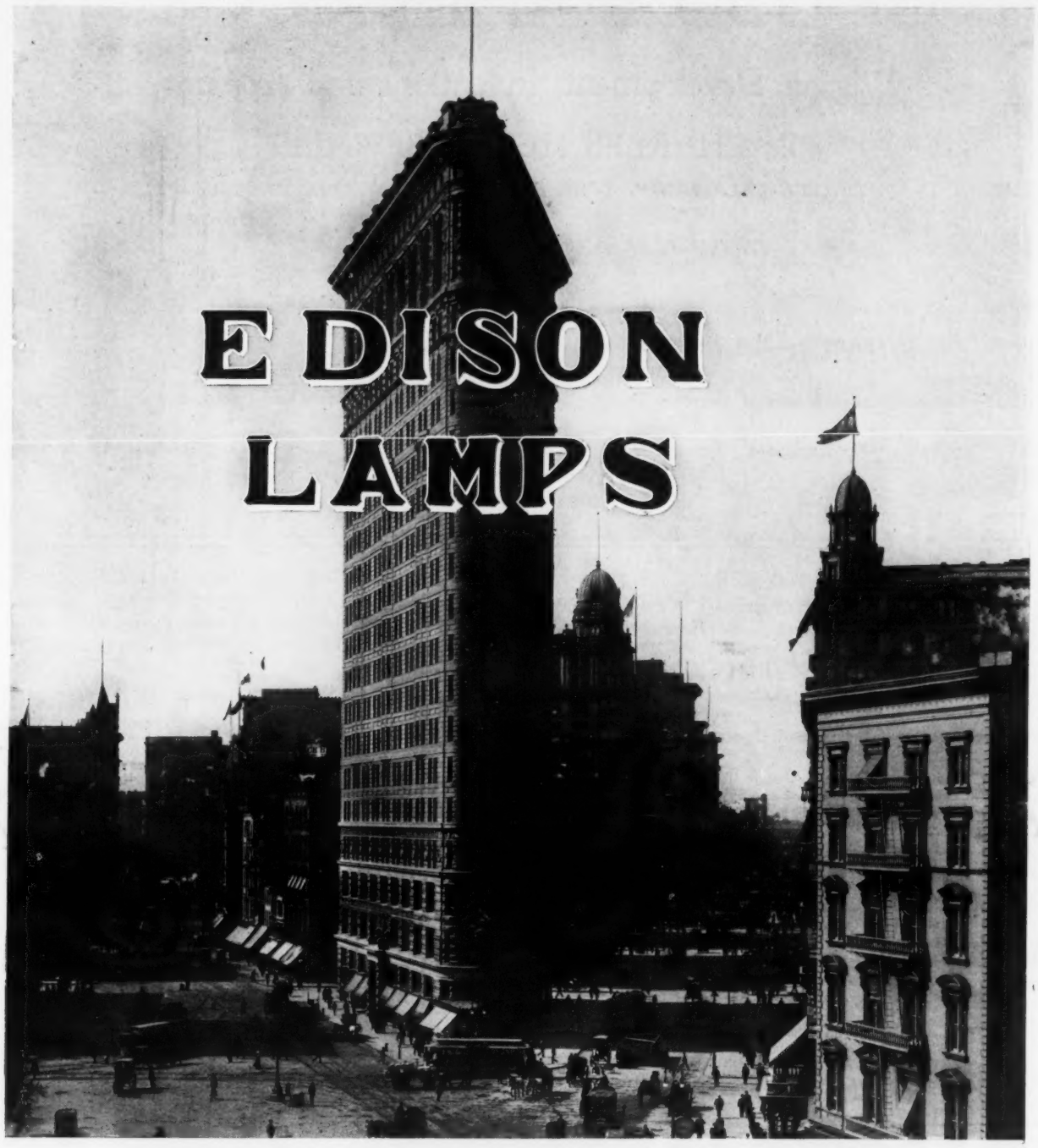

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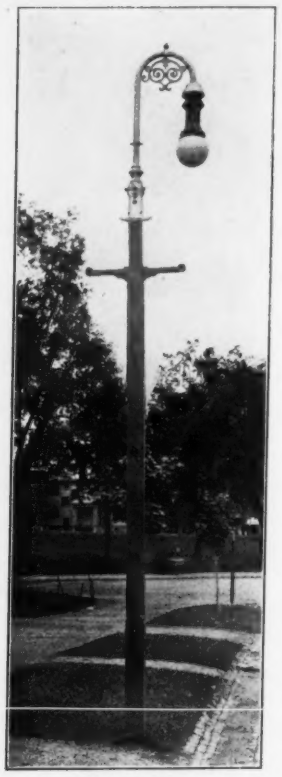

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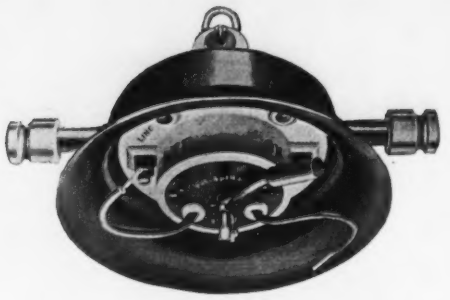

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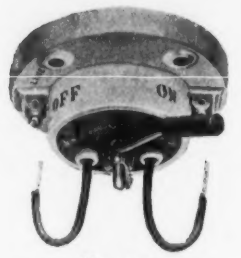

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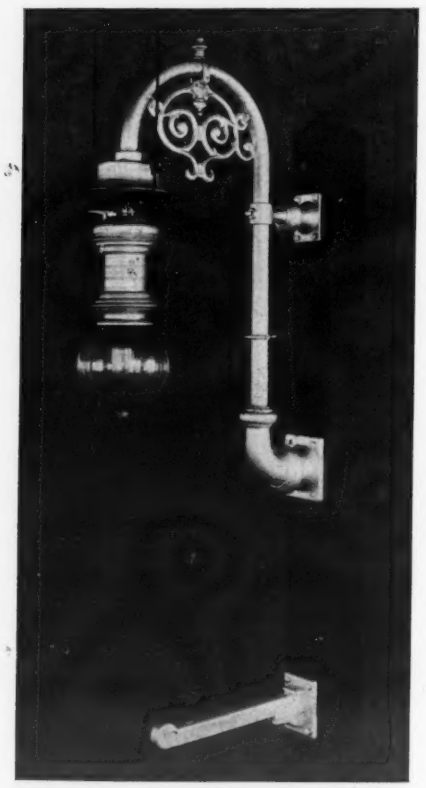

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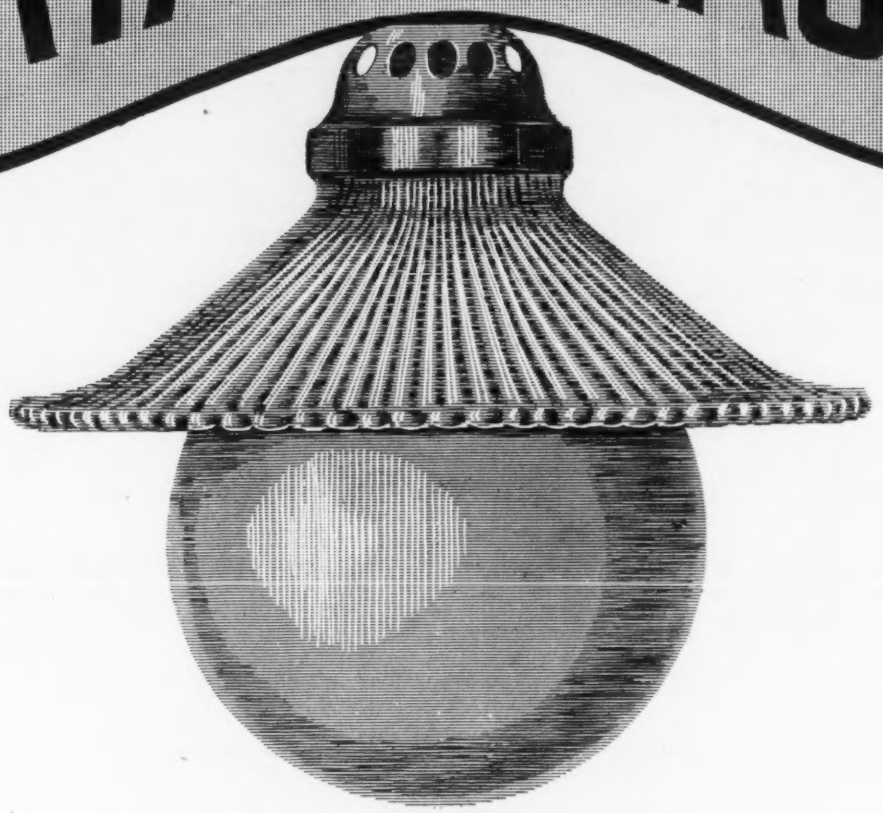

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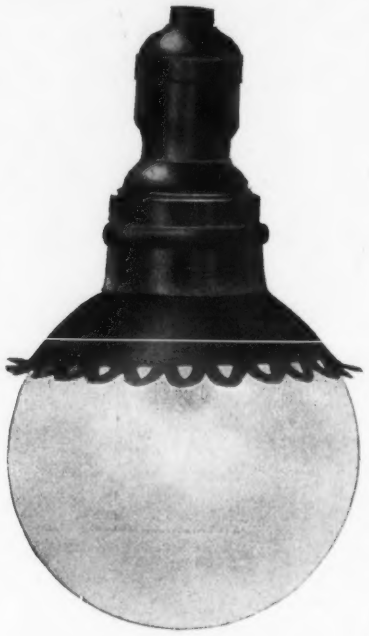

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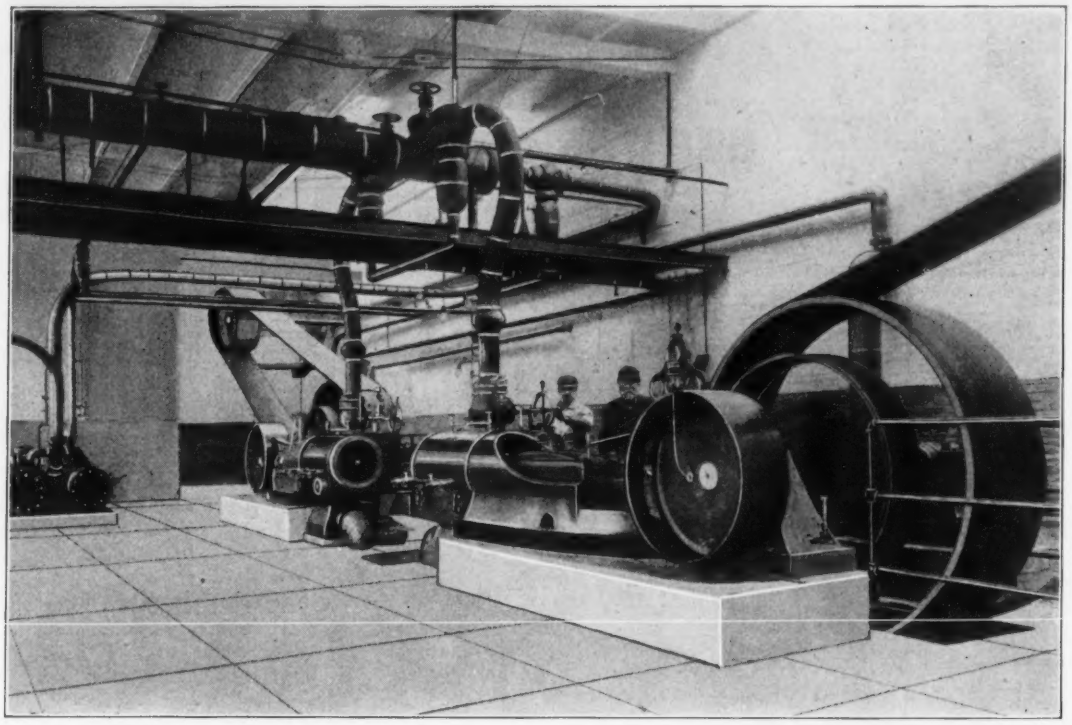

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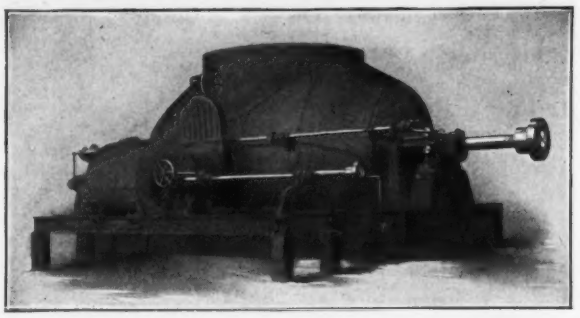

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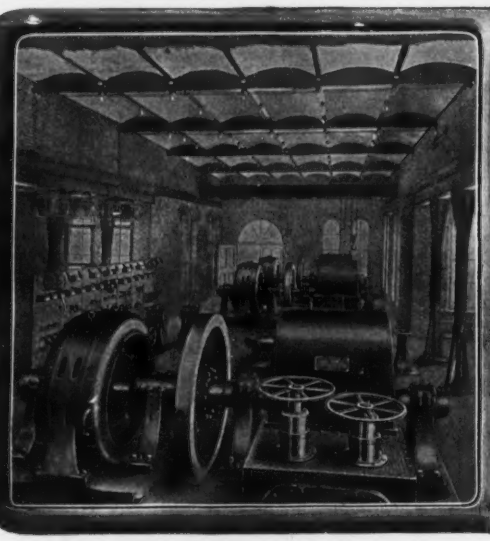

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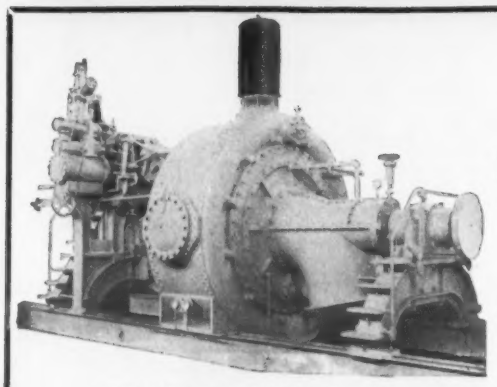

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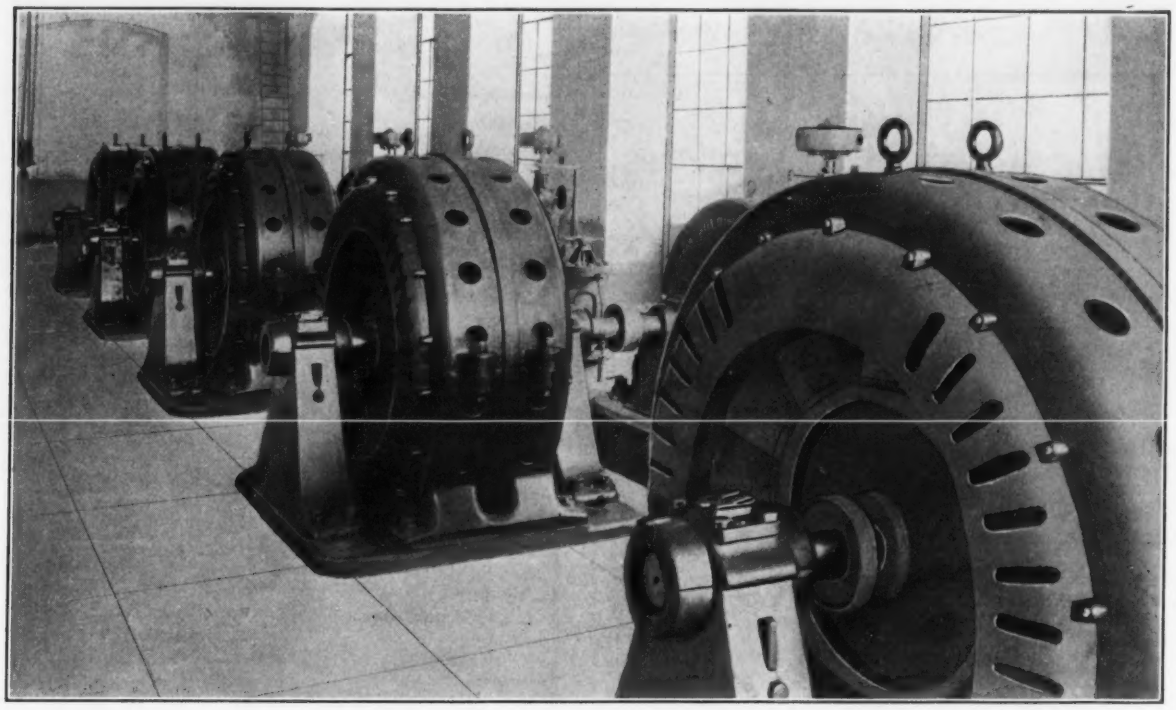

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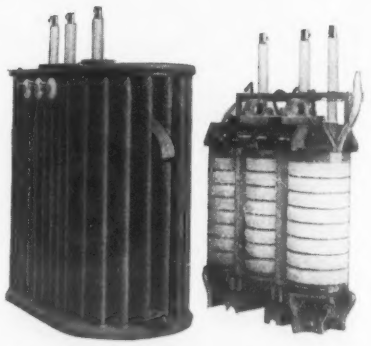

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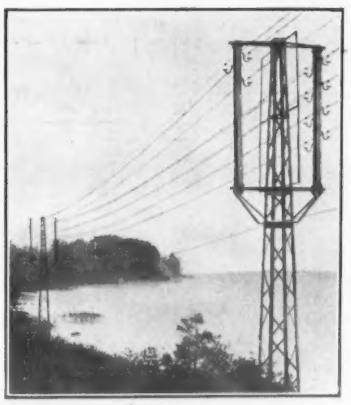

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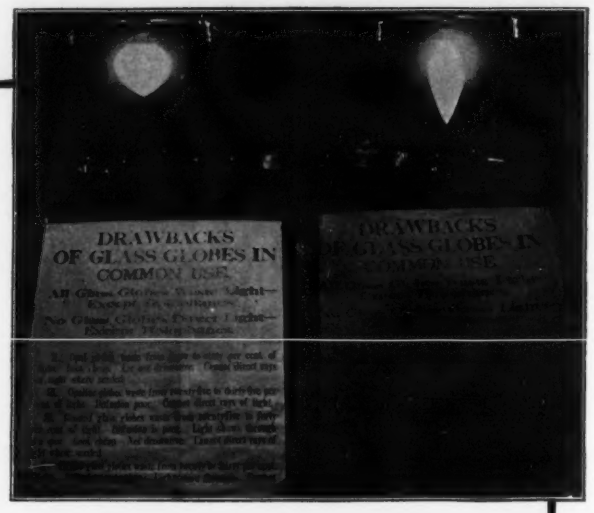

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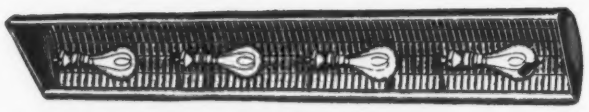

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